agriculture

Vol. 77 No. 8

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MONTHLY

Frost

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Agriculture

VOLUME 77 . NUMBER 1 . JANUARY 1970

Editorial Offices
Ministry of Agriculture, Fisheries and Food
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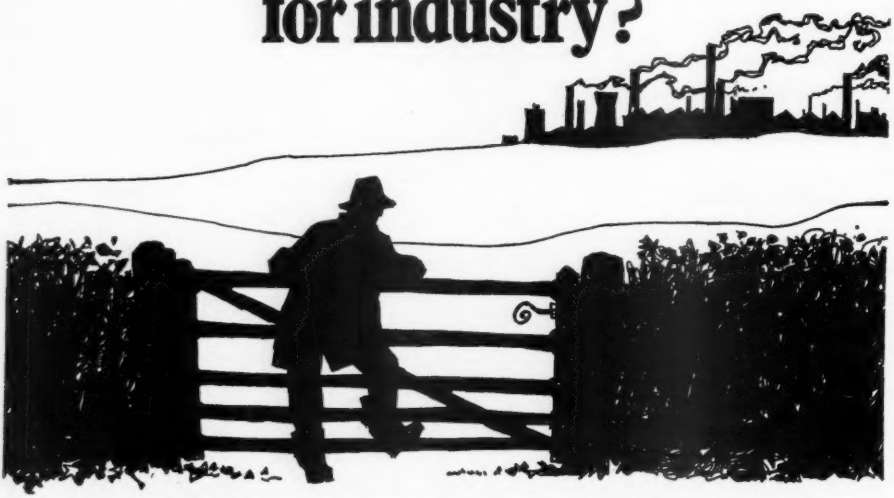
Who will do his work when he leaves you for industry?



Are you going to be able to carry on when labour gets even shorter? New electrical techniques for greater productivity will help. But unless you understand these new techniques and know how to use them you are going to get left behind.

Alive to the situation, the Electricity Council, in conjunction with the Institution of Agricultural Engineers, has organized a conference to help farmers and all interested in agriculture with these very problems. You are invited to—

AUTOMATION IN FARMING CONFERENCE

on 25th February, 1970 at The Institution of Electrical Engineers in London.

A very interesting programme has been arranged for you. Here are brief details.

The Electricity Council, England & Wales.

Chairman:
H. C. G. Henniker-Wright, Mem. A.S.A.E., F.I.Agr.E.

10.00 hrs Opening Address
N. F. Marsh, M.A., (Deputy Chairman, The Electricity Council)

10.30 hrs 'Electricity Supply and Installations on Farms'
H. H. Lawrence, C.Eng., M.I.E.E.

11.30 hrs 'Electric Motors – Types and Controls'
J. T. Taylor, M.I.Agr.E.

12.00 hrs 'The Application of Electric Motors'
G. P. Print, F.I.Agr.E.

14.15 hrs 'Automation – a Solution to the Drift From the Land'
G. Smith, N.D.A., N.D.D., F.I.Agr.E. and V. M. Owen, B.Sc., C.Eng., M.I.E.E., M.A.S.A.E., F.I.Agr.E.

15.00 hrs General Discussion.

Conference closes not later than 17.00 hrs.

Admission will be by ticket only. Tickets are available free of charge and coffee and tea will be provided. A Conference luncheon will also be available at 22s. 6d. per head. In the meantime, if you wish to participate please complete and return the coupon without delay, as accommodation at the Conference is limited.

AUTOMATION IN FARMING CONFERENCE
To: Mr. R. E. Halliwell, The Electricity Council, Trafalgar Bldgs., 1 Charing Cross, London, SW1.

I shall attend the Conference as a delegate .....

NAME .....

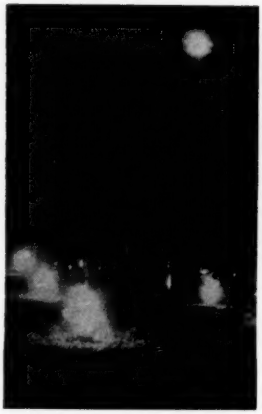
ORGANISATION .....

ADDRESS .....

I shall/shall not require luncheon at £1.2.6d. per head. *Please delete as necessary*

ACI

AGRICULTURE JANUARY, 1970



The author,

M. G. Banwell, N.D.H., of the N.A.A.S., East Malling Research Station discusses recent developments in frost control and climatic studies

Frost Protection

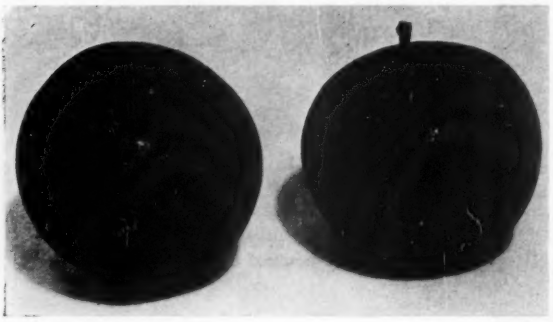
As a result of the increasing interest in the use of various frost protection methods, observational work on some of these has been carried out for the last three years in the South East. In 1969, seven sites, each half an acre in size, were laid out with a control area and various records taken of blossom truss counts, fruitlet counts and final counts in August. These have been compared with total crop from the heated and the control areas and in the case of two or three of the sites, once the fruit comes out of cold store, a grade analysis will be made.

This work was tied into that of Mr. R. R. Williams, at Long Ashton, and his pollination studies. Clearly, the last three seasons have assisted this work in frost protection and have, at the same time, increased grower interest. However, as a result of the more detailed work in 1969, various issues have arisen which are probably of greater interest when considering the future of the fruit growing industry in the country.

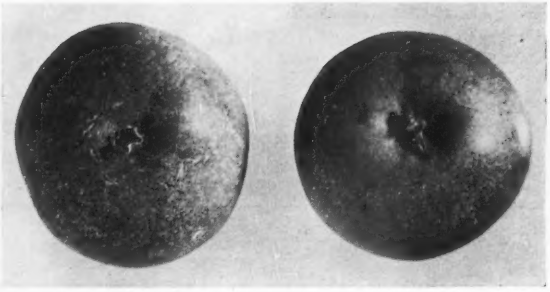
Fruit quality

The points of particular interest are those affecting the early development of foliage and blossoms, the set of the latter, the development of the fruits, including stalk length, and skin finish and the final effects on yield. Some of these points are no doubt inter-related but the whole question of fruit quality especially has been high-lighted this year in two of the sites. On all the sites that were heated in 1969, it was noticed that blossom was approximately two days earlier in flowering than in the unprotected areas. This may largely be

due to a case of the earlier blossom being killed or retarded. The unprotected blossom also had a much paler appearance and the flower stalks were very much shorter than in the heated areas.



Cold weather effects on length of flower stalk (Cox). Frost-protected fruit on right



Cox fruit from control area: (left) Russet round eye (right) frost-protected skin smooth

Types of heater

In 1968, work on heating was carried out with a prototype gas heater, using bottled propane gas and these heaters were efficient in increasing cropping when used around the flowering period. In 1969, the gas heater was very largely remodelled. Again, unfortunately, it was not possible to use it during early pre-blossom frosts but detailed recording of the heat lift was obtained when used in the flowering period. This heater is under construction by the British Oxygen Co. of Great Britain, but has not, so far, been priced.

The main method of heating in 1969 was in the use of a new product of the Agricultural Division of the British Petroleum Co. They have a by-product of the solvent industry in the form of a slack wax which has been developed into a wax heater and it is anticipated that it will be marketed in 1970. These heaters are some 14 lb in weight with a guaranteed burning time of ten hours.

Effect on crop

Following the earlier work of 1968 the heaters, in 1969, were used largely to ascertain whether various different amounts of heat, put in the orchard, would have a varying effect on the crop. They were used to give levels of 3

million, 4½ million and 6 million B.t.u's per acre hour. This meant a distribution of 120, 180 and 240 heaters per acre. Each orchard block used was half an acre in area and each block had a maximum/minimum thermometer and a thermograph in a screen.

At the site of Plant Protection Ltd. it was possible to borrow a 24-line Grant recorder and a very detailed set of records was obtained at various heights and positions in and around the blossom trusses in the heated trees. The results from the sites which have been heated are given in table 1, from which it can be seen that high yields were obtained from all heated plots.

Table 1

Percentage fruit set—frost sites 1969

Farm		Truss* counts	Fruit Nos.	Per cent set
A	1	2,024	1,309	10·8
	2	2,103	1,036	8·2
	3	1,656	904	9·1
	C	2,185	661	5·0
B	1	1,859	1,869	16·8
	C	1,782	929	8·7
C	1	1,690	469	4·6
	C	1,578	184	1·9
D	1	1,508	1,127	12·5
	C	1,674	579	5·8
E	1	1,608	2,072	21·5
	C	1,749	1,889	18·0

*Estimated flowers per truss = 6

One of the first points noted was damage to trusses, even before these trusses had developed into a flower cluster . The first set of figures shows this difference, where counts were made both at the normal truss counting period (bud-burst) and just prior to green cluster, see table 2.

Table 2

Fruit bud losses due to frost 1969

Farm	1st Truss count	2nd Truss count	Per cent loss of fruit bud
A	2,185	1,788	19
C	1,578	1,181	32

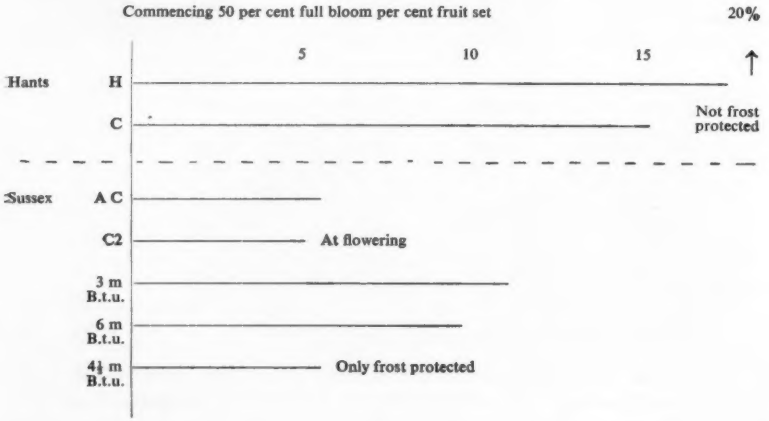
The reason why site 'E' was slightly different from the rest in its response was that this plot was in an area that was heated by other means and there is no doubt that, due to the size of the area, heat movement affected the control area. It is also possible that in view of the response in set, the Cox trees may have reached the stage of being unable to carry any more crop. This suggestion is supported by the pollination results that Mr. Williams is now studying. Together with the work on frost protection, following that done at Long Ashton on the effect of temperature on rate of pollen tube growth, some orchards were heated around the flowering stages, to achieve more rapid fertilization.

Heaters were turned on when the blossom had reached 50 per cent full bloom and when the temperature was about 55°F. There were problems in

doing this in 1969, due to the very high temperatures that occurred on some of the sites and the effects of wind which made lighting difficult on small plots.

At one site in 1969, however, interesting results were obtained from a farm which was not heated, due to its altitude, for frost protection. It was thought that one orchard, based on its past cropping records, called for some investigation as to why it had not carried the same high crops as the rest of the farm. The orchard area was at the bottom of a slope on the side of a hill, where cold air appeared to funnel down through the orchard—possibly getting held up. Heating was given at a rate of 3 million B.t.u's per acre. The results are shown in the following diagram.

Heating at flowering



Before the industry can be advised on heating, it must be calculated what the cost of giving protection is and whether, when one has spent this sum of money, the return justifies the expense. In many seasons in the South East, it is conceivable that frost or cold weather is affecting the blossom, lowering yields and may be affecting skin finish. Some evidence has been abstracted from the Long Ashton and East Malling reports on radiation frosts that have occurred over the last ten years during the blossom period for apples. Costs for water sprinkling, when one also includes the cost of reservoir construction, are rising. Many schemes today have been designed to conserve winter water and costs are often in the region of £700 to £900 per acre.

Figures obtained for a permanent oil heating system show that, subject to there being an efficient heater, the capital cost to include a tank, pump and piping might be in the order of £140 to £150 per acre. It is possible that a heater may be made this winter, or at least could be made this winter, from drawings approved by the oil engineers at B.P., from a burner seen in Holland in 1968. The capital cost for gas may be slightly higher, due to the need in the case of propane gas, for an evaporator to be coupled into the gas line. However, contact has been made with the Gas Council, seeking their assistance in the possible development of natural gas for those growers who have gas supplies near an orchard site.

There are now three wax-type heaters, costing about 7*s.* each, with a burning life of ten hours. These may have a use in areas that are not subject to a great deal of frost or that may, subject to the current work proving successful, have a use at a stage or stages of blossom development to increase set or fruit quality.

The 1969 results have drawn attention to the effects of heating on fruit quality but added to this are the effects of cold weather on cropping of young plantations, especially those planted as intensive systems requiring special treatments. Some of these, due to no crop in the fourth year, have in the last three years become difficult to manage.

Land reclamation should not be regarded as a last ditch stand against afforestation or amalgamation. The return on investment can be very high.

J. M. M. Munro, B.Sc., M.Agr. Sc. (N.Z.), Dip. Agr. (Reading),
of the Welsh Plant Breeding Station, Aberystwyth discusses

Reclamation of Hill Land

INTEREST in hill land reclamation has recently received new stimulus from the introduction of the Hill Land Improvement Scheme in the 1967 Agriculture Act. Provision is now made for the repayment of 50 per cent of the actual or standard cost of approved operations designed to increase the productivity of hill land directly or indirectly. These operations include cultivation and clearance, lime and fertilizer application, seeding, drainage and subsoiling, and the provision of roads, grids, pens, fences and shelterbelts. In addition, a further 10 per cent supplement is repayable in respect of field drainage.

This incentive comes at a critical period of transition in hill and upland farming in Britain when it is more than ever important, both on individual and national levels, to increase the productivity of hill land. The traditional market for wool, draft ewes and small store lambs in most years now offers a less encouraging prospect than fat lamb production.

Despite these trends, however, land reclamation should not be regarded as the last ditch stand against afforestation or amalgamation. If due consideration is given to the use of the most appropriate technique in each situation and its integration within the farm system, the return on investment

can be very high. In broad terms, the main alternatives are reseeding of the in-bye and drier hill, botanical improvement of the steeper slopes by controlled grazing, lime and fertilizers, or surface seeding of a proportion of the higher, wetter mountain.

Although the name of the Welsh Plant Breeding Station at Aberystwyth has been intimately linked with the development of reseeding over the past 50 years, equal attention has been devoted to other, perhaps less spectacular, methods of improving the nutritional value and production of hill grazings.* While the current research programme at the Pant-y-dŵr Hill centre in Radnorshire is mainly concerned with the evaluation of new varieties under upland conditions, considerable attention is also being devoted to the study of more basic problems of low production and intensification.

Future for reclamation

For various reasons, the most widely adopted method of reclamation, particularly in Wales, has been ploughing and reseeding with ryegrass/white clover-based mixtures. In the Principality alone, over 200,000 acres of rough grazing have been reclaimed from bent, fescue, bracken, gorse and mat-grass since 1952 under ploughing subsidy schemes. In the wetter, western counties of Caernarvon, Merioneth and Cardigan, a situation is being reached where the residual acreage is either too steep or rocky for cultivation or else forms blanket bog which is subject to rapid rush infestation after ploughing.

Further east in the Welsh border counties, in the North-east and in the Southern Uplands of Scotland, in areas where the rainfall is below 60 inches at 1,500 feet and mineral soils predominate, the potential for ploughing appears high. In many instances, however, other factors including common land ownership, low stocking intensity and the lack of access roads and subdivision fencing make alternative approaches essential.

Intensifying production from existing reseeded areas

While the expansion of the acreage of reseeding may be reaching ceiling point, considerable scope remains for improving the output from the existing in-bye. Despite the fact that low availability of soil nitrogen is characteristic of all hill areas, the use of fertilizer nitrogen remains at a negligible level. The statistics for Radnorshire in the 1966 Survey of Fertilizer Practice are typical. Only 24 per cent of the reseeded leys and 10 per cent of the permanent grass received any nitrogen in compound form, while on the treated fields the average application was less than 40 units per acre.

Experiments at Pant-y-dŵr (1,000 ft) have shown that by using 500 units of nitrogen on S.23 ryegrass/S.184 white clover pastures it is *technically* feasible to produce 10,000 lb of dry matter per acre. This is two-thirds of the output obtained from lowland paddock-grazing systems with similar inputs and three times the current production from most hill reseeds. While it is not suggested that this level of intensity will ever be economic in the hills, there is wide latitude for increased nitrogen usage of up to 120 units for silage, hay aftermath and foggage production.

Perhaps farmers have been made wary of nitrogen through traumatic experiences of its use for early bite. In 1969 at Pant-y-dŵr, the cost of nitrogen

*A detailed description of this work is included in *Studies on Hill Land in Wales* by Ll. Iorwerth Jones. Technical Bulletin No. 2, Welsh Plant Breeding Station, 1967.

per ton of additional dry matter produced by 1st July was over £40. This is by no means an isolated experience. Where out-of-season grazing for ewes and lambs is required in April only special-purpose crops such as winter rye, winter oats and S.170 tall fescue can be relied upon.

In addition, there is also room for improvement in current fertilizer practice at sowing. Provided adequate lime dressings have been given and sowing is not delayed beyond late July, fewer establishment failures are noted than was formerly the case. More readily available phosphate, potash and nitrogen in compound form would speed up establishment, while basic slag could be reserved for subsequent maintenance.

The disastrous spring of 1969, which had its greatest effect on some of the more intensively stocked farms, high-lighted the importance of winter feeding and also the use of winter hardy grasses in reseeding, especially on wetter land. Few grasses are capable of prolonged survival under these conditions, yet a wide range is currently used in practice. In trials carried out at a number of centres only timothy, red fescue and the late perennial rye-grasses have shown any merit. Even S.23 ryegrass suffered a 60 per cent reduction in yield in the period up to 1st July compared with 1968, while a mixture of all three grasses and white clover was only 20 per cent lower.

Improvement of the upper hill

In most areas the disappearance of older cattle and wether sheep from the farming system has resulted in a marked deterioration in the botanical composition, feeding value and overall utilization of the rough upper hill grazings. Large scale reseeding and enclosure of the lower hill has only accelerated the process. Despite an apparent abundance of summer keep, the overall digestibility is below that of poor quality hay. The following relative values for organic matter digestibility were obtained from Pant-y-dŵr in mid-July:

	% D.O.M.D.*
Molinia	51
Sheeps Fescue	42
Heather	22
Rush	27
Deergrass	48
Red fescue	65
Ryegrass	69
White clover	75

*Percentage D.O.M.D. or D is the percentage content of organic matter in the dry matter of a feed

Recent ewe nutrition studies at the Hill Farming Research Organisation in Scotland have shown that the quality of summer grazing is critical to lamb growth rate before and after weaning and to ewe performance in the following spring. A 4–5 unit increase in digestibility led to a 75 per cent increase in milk yield, which made all the difference between failure and ability to produce good twin lambs.

One of the best pioneering examples of the method of obtaining this improvement is provided by the Organisation's farm at Lephinmore in Argyll.* A hirsel of 1,000 acres was improved by enclosing two 100 acre paddocks and reclaiming 15 per cent of each by surface treatment and seeding.

*Details are included in *Hill Grazing Management and Increased Production* by I. A. Nicholson and others. Scottish Agriculture. Vol. XLVII. No. 3, Summer 1968.

Ewe numbers on the very poor heather, drawmoss and deergrass hill were increased by 82 per cent and weaning percentage by approximately 30 per cent in ten years.

The response of rough grazings to different types of surface treatment varies widely, depending on their botanical composition. In the case of drier banks with a high proportion of bent and sheep's fescue, marked improvement is obtained from lime and slag application and controlled grazing alone, while the addition of limited nitrogen top-dressing speeds the process.

In wetter areas where *Molinia*, heather or deergrass predominate and little or no bent is present, the response to similar treatment can either be negligible or even retrograde if the pasture thins out rapidly and moss takes over. The lack of response of these species to fertilizers is typified by an example from Pant-y-dŵr where the treatment of *Molinia* with 500 units of nitrogen in 1968 did not increase its yield beyond 1,000 lb of dry matter per acre. On the same poor peat, with the same treatment, S.23 ryegrass produced 7,000 lb but where no nitrogen was applied and no white clover was present, the yield was only 50 lb/acre.

Importance of white clover

Both from the point of view of its nitrogen fixing ability and its high feeding value, the introduction of white clover is vital to the improvement of the wetter hill grazings. Recent research in New Zealand, Ireland and Britain has reinstated clover to its former position of honour in fat lamb and beef production because of its high energy, mineral and protein content and digestibility. In preliminary trials under hill conditions at Pant-y-dŵr in 1969, the inclusion of S.184 wild white clover in S.23 ryegrass and S.59 red fescue paddocks greatly enhanced herbage intake, liveweight gain, wool production and wool quality.

In terms of nitrogen fertilizer the clover provided the equivalent of 600 units per acre over a three-year period, a net saving of over £10 per annum. Highly successful results in white clover establishment on wet land have been achieved without cultivation through the burning of *Molinia* in February and surface seeding in March before heavy rain. Cheap seed mixtures containing 30 lb of white clover cleanings with the addition of 2 lb each of S.23 ryegrass, S.59 red fescue and S.48 timothy were used. Three cwt of 20:10:10 fertilizer were applied with the seed but all lime dressings (2 tons per acre) should be applied during dry periods in the previous autumn. Where plantations prevent burning, similar results in removing accumulated debris have been obtained by the use of an old forage harvester.

Improved winter utilization

A new departure in recent years, which has already resulted in marked improvement of rough grazings, has been the use of urea self-help blocks for feeding on the open hill during winter. In effect, the blocks have a nutritional role similar to that of clover on the hill in summer, providing a source of readily available energy, nitrogen and minerals to balance the roughage from the hill grazings. Experience from the Pwllpeiran Experimental Husbandry Farm near Aberystwyth has shown their contribution to the basic aim of hill land reclamation; the removal of stock pressure on the lower in-bye and hill to increase the production of either fat lambs or forward stores.

A Market with a Future

Graham Kemp of Birds Eye is of the opinion that if the present rate of expansion of the frozen food industry is maintained it will ensure a stable market for peas, beans, sprouts and potatoes.

Developments in Frozen Foods

ASK the farmers of East Anglia to name the most valuable cash crop in their rotations and they will almost certainly mention peas or green beans. Many of the younger farmers will not be able to recall a time when they were not growing peas for the canners and freezers, but it is only 25 years since the first peas were grown for quick freezing in East Anglia. There are still a great many people in Britain who have not yet eaten frozen vegetables at all.

As a nation we spend about £145 million a year on quick frozen foods but that is only one-sixth of consumption of frozen foods in the United States. At 13·5 lb per head, that is even some way behind Sweden and Switzerland in per capita terms; American per capita consumption is 70·5 lb per head. The value of the market in 1980 is forecast as being something approaching £400 million, but you may believe this to be a conservative estimate.

At all events, the opportunities are considerable for vegetable growers and the introduction of new products by frozen food manufacturers could well open up new possibilities. One of the most important volume products in the United States is the frozen French fry–chips to the British. Potato products generally are very much more important there than they are in Britain, well ahead of peas in national popularity. The confidence of British manufacturers in the development in the market is seen clearly enough by the massive investment in plant and equipment since the early sixties. As much as £10 million is expected to be invested by the end of 1969 and every penny is needed to keep pace with the demands of the market place. The major part of this investment has gone towards new plant and equipment at the factories to keep pace with the developing technology of freezing and, at the same time, to maintain capacity for the volume required from growers and suppliers.

The technology, in both freezing and production, quickens every year. It is only four years since the first mobile pea viners were introduced into East Anglia, making it possible for companies like Birds Eye to exercise a strict 90 minute rule from vining to the factory. At one time, peas were taken on the vine to static vining stations, adjacent to the factories, but now the spent vine is thrown back on to the field and only the peas go to the factories. This means that farmers growing peas for quick-freezing peas operate in a tight

Mobile pea vining machines working on a crop grown under contract for Birds Eye in Lincolnshire

geographical area to ensure that shelled peas are not exposed for longer than is absolutely necessary.

A large quick-freezing factory will contract up to 15–20,000 acres from 2–300 farmers within a 30-mile radius. The factory sites are usually within easy reach of farms with a topography and land spread suitable for mechanized harvesting. A favourable fertility and climate for the crops is equally important and, in particular, a low harvest season rainfall.

It is for these reasons principally that so many of our largest quick-freezing factories are positioned in the eastern arable counties. The fact that three of our most important fishing ports are on the same coast is an additional and cost-saving bonus. East Anglian farmers now produce more than 40 per cent of all field vegetables grown in Britain; nearly 70 per cent of *all* vegetables packed for quick-freezing are grown in the eastern counties.

Growers in these areas now have sufficient faith in the growth of the frozen food market to risk considerable investment capital of their own. Farming syndicates were largely pioneered in association with companies like Birds Eye, but nowadays many growers for the quick-freezing companies have willingly formed themselves into machinery syndicates, owning their own mobile viners and negotiating special prices with the companies.

Co-operation between growers and companies is close and continuous, but Birds Eye recognize the need to keep growers aware of total developments in the market on a more regular basis and intends to hold many more meetings with growers for this purpose. The seed supplied by Birds Eye to its many growers has been developed over many years from varieties unused by the average grower and is designed to produce greater yields and improved quality. Birds Eye *petit pois* come from a special variety found by the plant breeder in Ethiopia and tested in the company's research laboratories, where more than 1,000 varieties have been tested during the past ten years. As few as 6–10 varieties are used commercially in any one year and some provide more pods on the vine than conventional varieties.

The company's experienced field staff work very closely with growers throughout the year, offering advice on all aspects of production and planning the harvesting operation when the crop is ready. The readiness is determined by instruments known as tenderometers and maturometers which, as their names suggest, give a reading of tenderness on a calibrated scale. The growers price is determined on weight *and* quality.

In 1969, Birds Eye, among other companies, invested in new plant for the reception and processing of peas, increasing capacity considerably for a very much enlarged volume.

The peas arrive from the fields in tanks and are tipped directly into hoppers deep in the ground which convey the peas directly through the processing lines for grading, blanching, inspection and, subsequently, quick-freezing. The old plate froster methods have now given way completely to blast freezing tunnels in which peas and other vegetables are kept bouncing along on a cushion of cold air for four minutes. They are then packed in large containers in the company's cold stores ready for repacking later in the season into cartons or handipacks.

Peas are far and away the most popular vegetable packed for quick-freezing but in recent years the popularity of dwarf beans has increased substantially and sprouts too are winning new customers. We each eat about 6 lb of beans every year, compared with about 14½ lb of peas. But in 1968, sales were nearly 100 per cent higher than in 1964 and in 1969 they will exceed the 1968 level of 21,000 tons.

Production of beans has been concentrated in the south eastern areas of England for some years. But Birds Eye now produces more and more in the extreme south where conditions have proved still more favourable. In the coastal plain around Chichester, there is a combination of warm climate and rich, well-drained soil which gives near Continental conditions for the dwarf beans used by the company.

Beans for quick freezing are now almost entirely harvested by mechanical harvesters which pluck the bean off the plant, leaving the vine in the ground. It is quite common to see five or six mechanical harvesters in a line stripping the farmer's field to meet factory demands.

Even greater changes are expected in the next five years. Emphasis will be placed on machines which eliminate waste in the field, reduce field bulk to minimize transport and disposal costs and prevent post-harvest deterioration. The pea pod picker, which takes the peas off the plant in the field and then takes them back to the factory for shelling, is already undergoing trials in this country, as are sprout trimming combines which cut the sprouts on the field to be taken back to the factory for grading and freezing.

We can expect to see further development of seed drills that drill the seed in soluble tapes to minimize the use of costly hybrid seed and allow better direct plant spacing. Impregnation of the tape with growth regulator, bird scarer, fertilizer, herbicide and pesticide, will surely complete the requirement.

Technical ingenuity in harvesting and processing is matched by the development of new products, essential for a growing industry. As much as 50 per cent of Birds Eye's current range was not available before 1965 and a substantial development programme is maintained at the company's modern development department in Great Yarmouth. There are nearly 200 different types of quick-frozen food in the retail cabinets (a great many more for the caterer) but the major part of the industry's annual turnover comes from only 20 products—peas, fish fingers, beans and beefburgers at the top of the list. Even so, the industry expects to see considerable expansion in new areas like Florida orange juice, dessert products like mousse and trifle, and the prepared 'cook-in-bag' casseroles.

The food service and catering industries now take about 15 per cent of the industry's total production, but this is expected to be a growing market for the industry as new systems are developed to improve catering productivity.

At the same time, considerable expansion is anticipated from the growing use of home freezers, now in nearly 200,000 homes but recognized by many people as the next big appliance on the average family's list. If the market follows the American example, the housewife's early enthusiasm for 'do-it-yourself' freezing will eventually give way to the bulk storage of commercially frozen foods. The value of this market alone is expected to reach £5 million by 1972.

The tastes of the average family and the buying habits of the housewife are unpredictable but few people doubt the ability of the frozen food industry to maintain its present rate of expansion. For growers in particular this must mean an assurance of stable markets for the principal commodities, peas, beans, sprouts, broad beans and potatoes, but it also means a stimulus to technological development which would otherwise not take place. Growers are adapting to forms of co-operation to meet the needs in a way that might have surprised their grandfathers.

Burning of Gorse

The burning of gorse is a regular and necessary practice on many farms. To minimize the risk to birds and other wildlife and to property, farmers who plan to burn gorse are urged to do so between November and March. Burning should be completed before the end of March to avoid the nesting season.

Precautions should be taken. Sufficient people should be present throughout the entire operation, adequately equipped with 'beaters' such as wet sacks, shovels or spades, to control the burning and prevent damage to adjacent land, especially forestry plantations, other woodland areas or buildings.

Essential precautions are:

1. Burning should be undertaken only on a calm day.
2. Burning should always be carried out into (against) the wind; never burn down wind.
3. Burn early in the day whenever possible and do not burn after dusk.
4. Ensure that there is an adequate firebreak between the area to be burnt and adjacent property when this includes forestry plantations, other woodland areas or buildings.
5. Notify neighbours in advance when burning is to be undertaken (at least 48 hours notice is desirable). If there is any doubt about the adequacy of the precautions necessary to prevent the spread of fire, the Chief Fire Officer and, in the case of forestry plantations, the local Forestry Commission Officer should be consulted. Make certain also that adequate arrangements are made beforehand to ensure the speedy calling of the fire brigade should the burning get out of control.
6. Never leave burning unattended.
7. Make sure that all fires are out before leaving the area. Return an hour later to check again.

H. A. Thomas, M.S. (Agric.Econ.), B.Sc., Regional Farm Management Adviser for the N.A.A.S. in the East Midland Region, discusses the investment consequences of rising land prices.

Capital Intensity in Agriculture

IN the last decade, agriculture has become a capital intensive industry, £10,000 of capital per man employed as compared with £5,000 in most manufacturing businesses. The basic cause of this capital intensity has been the sharp rise in the value of land. Since 1958, agricultural land sold with vacant possession has increased on average from £80 per acre to £250 per acre. Land as an investment during this period has provided a greater return than would have been obtained through investment in gilt-edge securities. Owners of land, in addition to obtaining a 200 per cent capital growth, have enjoyed a return of 2–4 per cent per annum at current levels of investment in the form of rent. At the same time, the working capital invested has nearly doubled (£20 to £40 per acre on arable farms; £50 to £100 per acre on intensive dairying farms), but the return has remained the same, 10–25 per cent. The actual rate of return that any occupier will receive depends upon the system of farming, type, size and intensity of enterprises, level of management, etc.

Various estimates have been made of the real estate and working capital employed in British agriculture. At current prices this would amount to approximately £11,000 million. In contrast to other industries, only 10 per cent (£800 million) of the current value of land and 20 per cent (£600 million) of the working capital is borrowed or on loan from outside sources. In most joint stock companies 90 per cent of the capital is 'borrowed' (Share Capital).

There is therefore a large equity of capital available within the industry. The problem facing those already in farming is the level of equity that they should retain in order that they can take advantage of the capital growth value of land. They must have sufficient capital invested in working capital to provide sufficient cash income to meet living expenses, provision for annual taxation, interest and repayment charges. They also need capital and income for reinvestment to make provision for long-term taxation such as capital gains and estate duty and finance the transfer of capital assets of the business to the next generation. They may even have to finance the next generation and will certainly not wish to retire into penury themselves.

Farmers have been able to service the capital required for the acquisition of land out of family resources and current income. As land prices continue to rise, farmers will have to use more extensively alternative methods of financing the purchase of land, using capital that is available outside the family business. In addition to estimating the rate of return for any capital investment, particularly investment in land, it will become more important to undertake a feasibility study as to whether the farm business, in the absence of income from other sources, can service existing and additional interest and repayment charges out of future cash incomes.

In making these calculations, farmers would be well advised to consult (in confidence) their N.A.A.S. District Agricultural Adviser as to the system of farming, the amount of additional working capital required and the level of income that could be achieved by following any particular farming system. After joint consultation with his accountant, banker and legal adviser he will need to ensure that adequate provision has been made to meet current and future taxation commitments and to allow a sufficient margin to service the additional repayment and interest charges that would arise from investing any further capital. The method of borrowing, as well as the term of repayment, level of interest, level of taxation, future prices, will all have to be considered in making these calculations. The farmer will need to add his own discount figure for the level of risk and uncertainty involved in any forward projection. Each case will be different and, apart from the size and system of farming, family objectives will need to be considered. In some cases it may be desirable to change the constitution of the family business to a partnership, a company or a trust and to obtain additional capital through floating public companies, entering leaseback arrangements, creating new landlord and tenant partnerships or obtaining city money through the Agricultural Mortgage Corporation schemes, coupled with or independent of borrowing against endowment assurances or investment trusts.

Individuals may have difficulty in attempting to service borrowed capital out of current income. However, for some farmers it is possible through cashing in or borrowing money against the collateral of the freehold value of the land, for cash to be available for each generation to live, maintain and expand the business, as well as to make provision for retirement and the transfer of personal wealth. Those already in farming may, by judicious borrowing, find sufficient cash out of current and future income to invest in land and to benefit from the capital growth element in land investment. There is a need for a greater understanding of the use of facilities already available and for farmers to work out the optimum use of capital to meet their own specific requirements. In many cases it is still possible to provide cash currently required, as well as to ensure the retention and ultimate transfer of wealth to the next generation. A later article will deal with this specific aspect.

Bulgaria Builds Glasshouses

D. J. Fuller

For the past 2-3 years the attention of Western horticulturists has been focused on the large-scale glasshouse building programmes of East European countries. Bulgaria has been in the forefront of these developments with some 1,500 acres of glass built in the past five years and plans to continue expansion at the spectacular rate of 250-375 acres per year.

The Bulgarian people have a long tradition as horticulturists and attar of roses from their famous Valley of Roses has been a much sought after constituent of expensive perfumes for generations. However, the country has no tradition as a producer of glasshouse crops and, in fact, at the end of the war, had less than one acre under glass. Some of the first glasshouse units were built to be heated either by water from the natural hot-water springs which occur in some parts of Bulgaria or by waste heat from the cooling water of power stations. These sources of heat were not found to be completely satisfactory and most units are now being built with oil-fired boilers and are located in the 'better light' areas of the country. There are now approximately 1,500 acres of glasshouses used for vegetable crops and 75 acres used for flower crops.

Situated between latitudes 41° and 44°N the country is more southerly than the South of France, but is affected by the extremes of the continental climate. Rainfall is low, the winters are short and extremely cold but the summers are very hot. Winter light is much better than in Britain, which means that a higher level of winter production is possible in the glasshouses, but it must be acknowledged that there are also serious disadvantages. Glasshouses cannot be cropped from late June to September because of extreme heat. It is, therefore, essential to grow crops through the winter to give a reasonable return on the capital invested yet, for the months of December, January and February, the fuel consumption is very high by our standards.

Glasshouses

A number of glasshouse types have been tried during the expansion programme. The largest individual units have been supplied and erected by Dutch manufacturers as a package deal, including heating and ancillary equipment. These are of typical 10 ft 6 in. span Venlo type construction and have been built in large blocks of up to 7½ acres each. East German designs are next in importance with both 10 ft and 20 ft spans in use. These have continuous ridge ventilators some 2 ft deep which open from the ridge outwards rather than from the base upwards. A limited number of 60 ft span Danish houses, with much superior ventilation, have been erected for carnations.

Ventilation in the large blocks has proved inadquate for Bulgarian summer conditions. Design changes to include completely removable sides are envisaged for future houses but, since these are still to be built in 7½ acre blocks, temperatures in the centres are still likely to be excessive.

For Bulgarian winter conditions the boiler capacity and pipe layout of many of the vegetable growing glasshouses is inadequate to maintain the temperatures which we would consider necessary for the production of good tomato and cucumber crops. In contrast, the flower growing houses have adequate heating systems.

Organization

The production of vegetable crops under glass is co-ordinated by the State Glasshouse Organization 'Orangerien'. Of the 1,500 acres of glass used for this purpose 950 acres are state owned, the remainder belonging to co-operative farms. The major glasshouse units are in the region of Plovdiv and Pazardjik in the Thracian Plain, but there are glasshouse units ranging from Sandanski in the south-west of the country to Slivo Pole on the northern border with Rumania. The largest single enterprise, at Pazardjik, has 145 acres of glass built as a continuous line of identical 7½ acre blocks. Consideration is now being given to building further units around Petric in the south-west of Bulgaria where light conditions are said to be better in winter.

One of the largest glasshouse units at Pazardjik

Flower production is the responsibility of the State Flower Organization 'Bulgartzvet'. Of the 75 acres of glass used for flower crops, 65 acres are state owned and only ten are owned by co-operative farms. Well over half the glasshouse area controlled by this organization is in and around the town of Welingrad, which, although quite high up in the Rhodope Mountains, is reputed to have a very high winter light level.

Export of vegetables is through the export organization 'Bulgarplod'. This organization has a fleet of refrigerated ten-wheeled trucks which travel throughout Europe and the Near East to deliver fruit throughout the summer. Rail transport is also used, taking 36–48 hours to reach the main markets. At present, most produce goes to East Germany and Austria but trial marketings have been made in most European countries.

Bulgartzvet is building up its own export organization and is making greater use of air transport, particularly in the winter. Trial marketings of flowers have been made in most European countries and as far afield as Japan.

Cropping—vegetables

Tomatoes account for some 70–75 per cent of the total glasshouse acreage, cucumbers 15–20 per cent and the remaining area is used mainly for peppers.

Tomatoes. Tomato sowing commences either in late July outdoors or about 10th August in heavily shaded houses with the sides removed. These plants, when planted into their final positions in mid-late September, commence cropping in late November-early December. Further sowings are made to provide plants for planting up to early December and some houses have January planted tomatoes following an autumn crop of cucumbers.

Total yields are in the 30–40 ton per acre range for overwintered crops and 45 tons is regarded as an exceptional yield. The main varieties for 1969 are Extase or Asix with some Topcross and Nemacross. The stated aim is to maintain day temperatures of 16–18°C (61–64°F) in winter and 18–22°C (64–72°F) in spring. Corresponding night temperatures are 13–14°C (55–57°F) in winter and 16°C (61°F) in spring. Four rows are grown in a Venlo bay and plant numbers vary from 11,000 per acre for overwintered crops to 13,000 for spring crops.

Little provision has yet been made for soil sterilization in the vegetable growing houses, but some plants grafted on to disease-resistant rootstocks are being grown. The crop is subject to the normal diseases of this country plus bacterial canker and a powdery mildew (*Leveillula taurica*) which is common on outdoor tomatoes in the Black Sea area.

Cucumbers. This crop is grown by the cordon system, mainly on straw bales. Some are grown as autumn/winter crops to be cleared in mid-January and followed by tomatoes. Others are grown to commence cutting in January and these are kept on until mid-June. Average yields are in the 80–100 tons per acre range but some 120 ton crops have been obtained.

The main variety is Sporu with some Greenspot and Delta while a Swedish variety Rea is under trial. Temperatures are quoted as 24–25°C (75–77°F) by day and 18°C (64°F) by night. Two rows are grown to a Venlo bay with 4,800 plants per acre.

Peppers. Peppers from September sowings are picked from late January onwards with yields in the 20–25 tons per acre range.

Cropping—flowers

Carnations account for 80 per cent of the flower acreage, roses 15 per cent and the remaining 5 per cent is used for chrysanthemum cutting production and miscellaneous pot plants.

Carnations. Carnations are grown as a two-year crop and winter quality is excellent in the high light intensity. Growing methods are up to our best standards with modern equipment, all crops being in isolated concrete beds which are steam sterilized before planting. Planting usually takes place between February and May. In the following summer, the plants are cut back fairly hard when temperatures become excessive in mid-June and are then expected to flower from October onwards. The usual planting distance is 8 in. × 8 in. but closer spacing is being tried and some 4 in. × 4 in. crops are being grown for one year only. Minimum temperatures are stated to be 6–8°C (43–46°F) by night and 10–12°C (50–53°F) by day.

The crops are mainly of the Sim varieties but fifteen selections have been made from the Chabaud types and three of these are almost ready for commercial use. These are Mechta (Cerise), Ognen Char (Red) and Zora (Dusky Pink). In trial plots these are being grown alongside the Sim varieties and have much larger blooms, although they are possibly more prone to calyx splitting.

Cutting production is carried out in 60 ft span Danish houses under conditions of the strictest hygiene and laboratories have just been built for large-scale meristem culture work.

Roses. Varieties and cultural methods have all been adopted from Western European countries except that the bushes are raised by budding outdoors rather than by grafting under glass. Midsummer is regarded as the rest period and the major pruning is given in August so that high-quality blooms are produced throughout the winter.

Chrysanthemums. Chrysanthemums are not grown for cut flowers but limited quantities of stock plants are grown to produce cuttings for sale to both East and West Germany.

The author, **D. J. Fuller, B.Sc., N.D.H.,** is the Regional Glasshouse Crops Adviser for the N.A.A.S. in the Yorks and Lancs Region. He visited Bulgaria to study glasshouse development—sponsored by the British Council under the Anglo Bulgarian Cultural Exchange Programme.

Research and higher education

All research is controlled by the Academy of Agriculture and under it the Research Institute for Vegetable Crops at Maritza, Plovdiv caters for work

on both outdoor and glasshouse vegetables. The station has some two acres of glass with more in the course of erection. With the exception of plant breeding, the type of work is comparable to that of our experimental horticulture stations rather than our research stations.

The Higher Institutes of Agriculture in both Sofia and Plovdiv provide 4½-year degree courses and some 160 students per year are taking degrees in the various branches of horticulture. A high proportion of the graduates are directly employed on the planning and supervision of the commercial cropping programmes.

Economic aspects

The primary object of the glasshouse building programme is to provide produce for export to earn foreign currency. Labour costs are relatively low but this is counter-balanced by the long haul to the main markets and the fact that standards of vegetable crop production are not up to those of our better growers. However, with cropping throughout the winter, produce prices are high and the return in foreign currency is considered high enough to justify the captial expenditure.

This additional 1,500 acres of glass is bound to affect the overall supply position in Europe, especially when linked with the expansion in Rumania and other communist countries. Expansion is planned to continue at the rate of 250–375 acres per year, but there are now reports that the level of capital investment is being reduced and the impact on the market may, therefore, be less than was at one time expected.

Schemes for the Inspection and Certification of Growing Crops of Potatoes (England and Wales) 1970

Growers of seed potatoes in England and Wales who intend to enter crops in the 'S.S.' and 'A' certification schemes are reminded that applications for soil sampling cannot be accepted after 15th March 1970. Growers who have not done so should apply to Plant Health Branch, Ministry of Agriculture, Fisheries and Food, Great Westminster House, Horseferry Road, London, S.W.1, for copies of the application form HI.8.

It is a condition of the Scheme that crops are not eligible for 'S.S.' or 'A' certification unless they are grown on land which has not carried a potato crop in any previous **four years** and which has been soil-sampled by an officer of the Ministry and found to be free from potato cyst eelworm.

A scientific assistant at the Official Seed Testing Station examines barley for loose smut infection

Smutted Cereals

P. D. Hewett

SEVERAL fungi can cause smut diseases of cereals in which grains do not develop in the ears. Instead, masses of dark fungus spores are produced in the 'smutted' ears which do not contribute to the yield. The blackened ears that farmers saw so commonly in June and July were due to loose smut. The approved organo-mercurial seed treatments do not affect the fungi causing the loose smut diseases of barley and wheat, although their regular use ensures that the other cereal smuts remain unimportant in this country.

Loose smut-attacked ears are easily seen at ear-emergence; as the black spores are blown away, with no apparent spread of the symptoms, farmers may be deceived into thinking that the trouble is over. The ripening and harvesting of the remaining ears can proceed as usual but the fungus is already well on the way to causing more trouble if the grain is intended for seed. Infective spores from the smutted ears were distributed over the crop at the flowering stage and re-infection took place then. At harvest, the loose smut fungus is sited snugly in the embryo—out of sight and too often out of mind also.

Crops at risk

The air above many crops of barley last summer must have contained around one thousand smut spores per cubic foot; these spores were ready to take advantage of any favourable conditions. The weather plays a large part in determining the proportion of re-infection, although insufficient detail is known to be able to predict accurately. Infection is favoured by frequent light showers, whereas heavy rainfall reduces the chances of re-infection by washing spores down to the ground. When weather conditions are favourable, there may be a build-up of infection and increases of from two to ten times have been recorded frequently. In hot, dry summers the

fungus is less successful and the amount of smut in a seed stock may decline. The last few years seem to have favoured loose smut re-infection and it appears that the build-up in some crops was considerably greater than previously recorded. The loose smuts of wheat and barley do not cross-infect; thus spores from barley cannot infect wheat crops, and *vice-versa.*

Protective mechanisms

Differences in susceptibility to loose smut occur in current commercial varieties of both wheat and barley but the mechanism differs in the two cereals. In wheat, resistance is to specific races of the fungus and, as many farmers now realize, varietal recommendations may be changed when new races make their appearance; fortunately the emergence of new races has been slow. The degree of resistance in present-day barley varieties depends on how difficult it is for spores to obtain entrance to the flowers. In the highly-resistant variety Proctor most of the flowers do not open and, therefore, access to them is denied to smut spores whatever their race. This mechanism does not give an absolute resistance but has the advantage of being permanent.

Many organisms are very prolific, one individual producing large numbers of eggs, seeds etc. The lack of conditions suitable for their development keeps us free from plagues, whether of fleas, frogs or elm trees. Loose smut fungi are prolific too but must have a suitable host plant in which to develop. When suitable plants (i.e., susceptible varieties) are abundant the fungus can increase rapidly. In a resistant (i.e., unfavourable) host population the planting of small amounts of susceptible plants will have little effect at first as they will, in the broadest sense, be isolated. But as susceptible varieties become more popular they increase the chances of a disease re-infecting successfully. The more re-infections occur the more infective spores will be produced and thus in turn increase the number of re-infections unless increasingly stringent control measures are adopted.

Situation in barley

The increasing acreage of barley over the past years and the replacement of Proctor with highly susceptible varieties like Zephyr and Sultan has undoubtedly contributed to the current high levels of loose smut. A preliminary survey, published in the current Journal of the National Institute of Agricultural Botany,* showed that susceptible varieties contained about twenty times as much infection as Proctor, and a yield loss of at least 100,000 tons was estimated for 1969. Not a catastrophe but a significant come-back, placing loose smut among the diseases which contend for second place to mildew in the loss stakes.

Loose smut has only one chance of re-infection per year, at the flowering stage, whereas rusts, mildew and Rhynchosporium may produce successive crops of spore-producing lesions throughout much of the growing season. Therefore, sanitary measures aiming to reduce the numbers of infective spores and, thereby, the chances of re-infection, can be simpler but still effective.

*Fellows of the N.I.A.B. receive the Journal, Newsletters and Recommended Lists of varieties as soon as they are published.

Embryo test for barley

In an infected barley grain the fungus is present as microscopical brown threads which form a streaky network between the embryonic cells (see photograph below). After suitable chemical processing, separated barley embryos can be examined under a microscope and a trained technician is able to recognize and count those that are infected by the fungus. Since 1957, a routine testing service has been provided by the Official Seed Testing Station, Huntingdon Road, Cambridge. Details of the procedure for submitting samples for testing can be obtained on request; the fee for a test is 50*s*. [£2·5].

The results of an embryo test tell us not only the extent to which re-infection took place but, for a barley sample, also predict the level of smutted ears which will be produced if that sample is sown. In most cases the predicted values are reflected clearly in the crop, although particular seedbed conditions may sometimes reduce the agreement between the embryo result and subsequent ear counts in the field.

A barley embryo infected with loose smut (Ustilago nuda). The fungus is well developed in the scutellum on the right-hand side

Re-infection in barley, 1969

The results so far obtained on samples harvested in 1969 suggest that in the majority of places the fungus did not increase its level of infection. However, local conditions determine the extent of re-infection. In Anglesey, for example, crops with ear counts of 5–10 per cent produced seed with embryo counts of 5–10 per cent, and some N.A.A.S. plots there showed marked increases, presumably due to spores from commercial barley surrounding the plots. At Cambridge, plots of Sultan with an average count of 0·6 per cent have shown embryo re-infection averaging 0·4 per cent.

Samples of barley sent in by farmers and merchants are again showing high levels of embryo infection. In the popular winter variety Maris Otter loose smut was found in about two-thirds of the samples; infected samples had an average of 0·3 per cent embryos infected. In susceptible spring varieties the levels are still very high; results at the time of going to press are given in the table below. When compared with the previous year's figures a slight improvement is indicated, but a final judgment must await an accurate survey.

Embryo infection in routine disease test samples described as Zephyr or Sultan

	1967–68	1968–69	1969–70*
% samples infected	91	92	94·5
average % embryo infection	0·7	2·2	1·4
highest individual infection %	4·4	23·0	14·8

*results at going to press

It seems that when loose smut is abundant, infection levels can remain high even when weather conditions do not obviously favour an epidemic. If future crops are to show an improvement careful selection of seed will be needed.

Production of clean seed

Clean seed, when grown away from smutted crops, will produce clean seed. When loose smut is common the selection of a really clean stock is not always possible and seed treatment has to be used. Despite certain drawbacks, hot-water treatment has been much used in recent years and has undoubtedly greatly assisted seed merchants and others interested in minimizing the incidence of loose smut in stocks of seed.

The specific virtues of 'Vitavax', a new chemical seed treatment against loose smut, have been widely mentioned in the agricultural weeklies. Commercially available as a powder mixed with an organo-mercurial it has already proved very valuable in the fight against smut and particularly good control has been obtained on barley. Results from the Continent indicate that it may be slightly less effective on wheat but further experience is required to determine whether this is merely some effect of the formulation. The actual amount of powder applied is about the limit that seed can be expected to carry; to achieve satisfactory results other powder treatments must not be applied before or after treatment with existing 'Vitavax' formulations. A slurry formulation would be a more efficient means of getting the correct amount on to each seed and may be developed. When seed is treated, a statement of the nature or the proprietary name of the treatment is legally required to be given on sale of the seed.

Other chemicals have been found to be active against loose smut when applied to seed but only limited information is at present available. While treatment remains costly it will not be applied indiscriminately to all grades of seed but restricted to the earlier multiplication grades.

During later multiplications of seed stocks field inspections enable the better stocks to be selected. The British Cereal Seed Scheme checks on possible build-ups of smut by taking field counts of smutted ears; crops are rejected or treated when counts exceed certain stated limits. But ear counts reflect the original embryo infection in the seed sown and give only a rough indication of the smut level in the seed to be harvested. Allowances should be made, since it seems that increases are more usual than decreases in our climate. An isolation distance of fifty yards is recommended; this precaution against

re-infection from outside sources of smut should be regarded as a minimum when trying to produce really clean seed. As loose smut increases more quickly in susceptible varieties, it would be an advantage if standards for susceptible varieties were appreciably stricter than the relatively lax standards allowable for resistant varieties. Probably only one-tenth as much smut should be tolerated in susceptible varieties.

Varietal resistance in the future

Most winter wheat varieties are susceptible to one or other of the races of loose smut and this situation does not seem likely to change at all rapidly. Most spring barleys are susceptible, as there are practical difficulties in incorporating the closed-flowering type of resistance into a breeding programme. But varieties now being grown in Canada possess another type of resistance and are immune to loose smut infection. Both malting and feeding barleys which give this immune reaction are now available there, and the disease is no longer regarded as a problem except in areas where older varieties are grown. At least one European variety is thought to give a similar immune reaction to loose smut and tests at the N.I.A.B. are confirming this. Eventually this resistance may become another valuable tool in the armoury of the plant breeder.

For 1970

A combination of the control measures outlined above is essential to reduce the trouble and loss caused by loose smut. Farmers who insist on growing high levels of infection, in cereals 'just for feeding', should be made aware of the re-infection problems that they may cause for themselves and their neighbours. Conscientious observation of sanitary precautions should be enough to enable clean seed to be produced regularly, allowing the cereal breeder to concentrate on producing varieties resistant to the foliar diseases—mildew, Septoria, rust and Rhynchosporium.

This article has been contributed by **P. D. Hewett, B.Sc., A.R.C.S.**, seed mycologist at the Official Seed Testing Station, a branch of the National Institute of Agricultural Botany, Cambridge. Mr. Hewett has paid particular attention to the incidence and importance of seedborne diseases of cereals.

Storage of Poisonous Substances

Careless storage of pesticide products can lead to accidents. Now that the main spraying season is over, users should take stock of the chemicals they have left. Full and partly-used containers should be stored under lock and key away from food, feedingstuffs, seeds and fertilizers, and where neither children nor animals can get at them. Pesticides should be kept in their original containers and care should be taken to see that these are tightly closed, that they do not leak, and that they are clearly and indelibly marked to show what they contain.

This article, prepared by G. Wight, B.Sc., M.R.C.V.S., refers to the recommendations contained in the Report of the Committee of Inquiry on Foot-and-Mouth Disease 1968 Part One. (Cmnd. 3999).

Foot-and-Mouth Disease

FOOT-AND-MOUTH disease is the most contagious of all animal diseases. The virus which has more than 50 sub-types affects cattle, sheep, pigs, wild ruminants and hedgehogs. Susceptible animals are infected with foot-and-mouth disease virus by direct contact with an infected animal or they may contract the disease indirectly through contact with material contaminated with the virus. Foot-and-mouth disease varies in its virulence but in general the death rate in adult animals is not high. The death rate may be higher in young calves and pigs; also in ewes and lambs during the lambing season. The majority of animals in an infected herd make a gradual recovery after three or four weeks, but in a dairy herd an economic production level is seldom reached during the current lactation and permanent damage may result leading to the necessity for heavy culling. The disease, if uncontrolled would reduce production in a susceptible dairy population by about 25 per cent.

In October, 1967, the first outbreak of foot-and-mouth disease, in what was to become the worst recorded epidemic in this century, was reported at a farm near Oswestry, Shropshire. The epidemic, which lasted until 4th June 1968, caused 2,364 outbreaks, involved eighteen counties in England and Wales, 2,346 farms (eighteen of them on two occasions), and resulted in the slaughter of 433,987 animals, comprising 211,825 cattle, 113,766 pigs, 108,345 sheep and 51 goats. The agricultural industry was gravely affected and the consequential disturbance and loss to many other interests were substantial. The direct cost to the Government of the epidemic was estimated at 35·1 million pounds. Total costs, including loss of income to farmers and the general disruption of agricultural production marketing and distribution, were difficult to quantify and estimates ranged from £70 to £150 million.

As a consequence of the epidemic in February 1968, the then Minister of Agriculture, Mr. F. Peart, appointed a Committee of Inquiry on Foot-and-Mouth disease with the Duke of Northumberland as Chairman. The other members of the Committee were Mr. A. Cripps, Q.C., Professor D. G. Evans, Mr. C. H. Plumb, Sir Edward Thompson, Professor D. Walker and Professor Sir William Weipers. Later Mr. E. L. Thomas was appointed as an additional

member. The terms of reference of the Committee were: 'To review the policy and arrangements for dealing with foot-and-mouth disease in Great Britain and to make recommendations'.

In presenting Part one of the Committee's Report (Report of the Committee of Inquiry on Foot-and-Mouth Disease 1968 Part One (Cmnd. 3999)*) which was made public on 1st May 1969, the Committee explained that priority had been given to considering the ways by which the risk of the introduction of foot-and-mouth disease into Great Britain, and the risk of future epidemics might be reduced. The major task of the Committee had been, therefore, to accumulate and evaluate the available scientific evidence and to weigh up the advantages and disadvantages of various possible policies. In collecting this evidence the Committee had held twenty-nine meetings in this country and had visited seven countries overseas. Overseas visits had been made to hold discussions on foot-and-mouth disease and to obtain evidence regarding control programmes and the disease situation in those countries. An Appendix to the Report gives an extensive list of those bodies and individuals who had given oral or written evidence to the Committee.

The opening chapters of the Report deal comprehensively with the disease, its epidemiology and world wide distribution. Among the factors discussed which may contribute to the spread of disease are wind, carrier animals and the movement of milk and milk products. There follow chapters providing information on the history of the disease in Great Britain from 1954 to 1967 and a detailed history of the 1967/68 epidemic, describing the development of the outbreak from its beginning in October 1967, its origin, spread and cost. Reference is made to the Report by the Chief Veterinary Officer on the origin of infection of the epidemic (Cmnd. 3560). This report is produced as an Appendix to the Report. The Committee concluded that it was impossible to establish without doubt the origin of the epidemic. However, having considered all the facts it was thought that there was a basis for a reasonable inference that the most probable source of the epidemic was infected meat from South America. A chapter details the methods of prevention and control of foot-and-mouth disease in Great Britain and in other countries. A description is given of general and barrier vaccination as preventative measures and ring vaccination when disease occurs in countries overseas.

The following chapter is a discussion of possible future policies for Great Britain outlining the three main policies for dealing with the prevention and control of the disease:

1. An import policy designed to reduce the risks of introducing the disease into the country by restrictions on imports which may carry the virus.
2. A slaughter policy designed to isolate and stamp out outbreaks of the disease when they occur.
3. A vaccination policy designed either to limit the number of primary outbreaks as well as the subsequent spread, or solely to limit the spread of the disease when primary outbreaks occur.

The Report ends with recommendations, preceeded by an explanatory preamble, which is worded as follows:

'Our recommendations for reducing the risks of the introduction of foot-and-mouth disease, and for controlling its spread, are based on a consideration of various policies including slaughter, import control and vaccination and on our judgement as to which of these are appropriate to Great Britain.

*Available from H.M.S.O. (addresses on p. 48) price 15*s.* [75 *p*] net.

'We have shown that there are substantial gaps in our scientific knowledge of foot-and-mouth disease, particularly in relation to some aspects of epidemiology. It is not possible, therefore, to make recommendations regarding prevention and control policies purely on scientific grounds.

'We have attempted to assess the gradient of risks of the introduction of foot-and-mouth disease in meat and meat products. The degrees of risk will depend on Government policy. The risks would be greatest if there were unlimited importations of meat and meat products from all countries, irrespective of their foot-and-mouth disease status, and least if meat were imported only from foot-and-mouth disease-free countries such as Australia and New Zealand. Between these extremes there are varying degrees of risk depending on what restrictions are applied to imports of meat and meat products and offal, and on whether such imports have their origin in countries where the disease is sporadic and the risks are less, or in countries where the disease is endemic and the risks are greater. We have pointed out that the major risks derive from the persistence of foot-and-mouth disease virus in bones, offal and lymph glands, and we think that if a policy is adopted which excludes these dangerous components, the reduction of risk would be almost equivalent to that which would be achieved by a complete ban on meat imports.

'Slaughter, which is the best method of eradicating the disease is essential whatever policy is adopted, but the adoption of a policy which relies on the slaughter policy alone should, in our view, be dependent either on a complete ban on imports or at least on the exclusion of the dangerous components of meat from countries or areas of countries where foot-and-mouth disease is endemic. If these dangerous components are not excluded we think it essential that some form of vaccination should be introduced.

'General vaccination gives a large measure of protection but this advantage has to be balanced against the disadvantages attaching to the disturbance of normal farming practice, the diversion of veterinary manpower and the very considerable cost.

'Ring vaccination would not limit the number of primary outbreaks but it could limit spread. Although it has considerable disadvantages, we think that in certain conditions ring vaccination could be a useful adjunct to slaughter.'

The Committee's recommendations are:

1. We recommend that the slaughter policy, which we consider to be the best method of eradicating foot-and-mouth disease when it occurs in Great Britain, should be continued. This policy by itself should only be adopted if the conditions of meat import policy are such as to reduce substantially the risks of primary outbreaks occurring. If such conditions of meat import policy are not put in force we would recommend that the slaughter policy should be reinforced by a ring vaccination scheme.

2. The conditions of meat import policy which in our view are necessary to enable the slaughter policy by itself to be continued and which we recommend are:

(a) (i) The ban on imports of mutton, lamb and pigmeat from countries or areas of countries where foot-and-mouth disease is endemic should continue.

(ii) Imports of mutton and lamb offal and pig offal from countries or from areas of countries where foot-and-mouth disease is endemic

should be limited to offal processed in such a manner as to destroy foot-and-mouth disease virus.

(b) Because there is a high risk of introducing foot-and-mouth disease into Great Britain by importing carcase beef and beef offal from countries, or from areas of countries, where foot-and-mouth disease is endemic, on strictly animal health grounds there should be a complete ban on all such imports.

(c) Alternatively, if for social, political or commercial reasons the recommendation in (b) is not accepted, imports of carcase beef and beef offal from countries, or from areas of countries, where foot-and-mouth disease is endemic should be limited to—

(i) boned-out beef; and

(ii) beef offal processed in such a manner as to destroy foot-and-mouth disease virus.

3. We recommend that:

(a) Our veterinary staff in South American countries should be strengthened in order that standards of public health inspection acceptable to the British Government can be ensured and so render the retention of lymph glands in boned-out cuts of meat unnecessary, and in order to assist the implementation of the Bledisloe arrangements.

(b) Because some countries in which foot-and-mouth disease is endemic have well-defined areas which, for geographical or other reasons, are free of the disease and which could be accepted as safe sources for imports of meat, provision should be made to permit imports of meat, under suitable safeguards, from such areas.

4. We recommend that contingency plans for the application of ring vaccination should be kept in constant readiness. They could be put into operation should our recommendations in 2 not be successful in limiting the number of outbreaks.

5. We recommend that the importation of meat and meat products from all sources should be subject to revocable conditional licences.

6. We recommend that adequate facilities for cleansing and disinfection of vehicles and persons engaged in the transport of livestock should be a legal requirement at appropriate points of entry into Great Britain.

7. We recommend an expansion of research work on foot-and-mouth disease, particularly in epidemiology, on the lines suggested, and the use of epidemiological teams in the field.

The Report ends with a dissenting note from Anthony Cripps, Q.C., in which he recommends the immediate application of ring vaccination to any outbreak.

Following publication of the Report, the Government decided that the Animal Health and other interests could best be served by accepting the Committee's recommendations to continue the existing ban on imports of mutton, lamb and pigmeat (including unprocessed sheep and pig offals) from countries where foot-and-mouth disease was endemic and by limiting imports of beef from these countries to boneless beef and processed offals. The new arrangements were introduced on 1st October, 1969. With the adoption of

the Committee's recommendations on meat imports it is proposed to continue to rely on slaughter by itself to eradicate foot-and-mouth disease and the Committee's recommendation to prepare contingency plans for ring vaccination has also been accepted.

The Minister of Agriculture stated that he accepted three other recommendations in principle which were an extension of the use of revocable licences for the importation of meat and meat products, the cleansing and disinfection at the point of entry into Great Britain of vehicles engaged in the transport of livestock, and the setting up of epidemiological teams.

Since the Report has been published the Government has acted on another of the recommendations of the Committee by strengthening our veterinary staff in South America.

Part Two of the Committee's Report (Cmnd 4225)* dealing with a review of the arrangements for controlling outbreaks of foot-and-mouth disease in Great Britain was published on 16th December, 1969. This part of the report mainly covers such matters as restrictions essential to contain the disease, organization, administration, procedures relating to slaughter and disposal of carcases, essential controls on movements of people, animals etc., sanitary controls and ancillary matters such as compensation.

*Available from H.M.S.O. (*addresses on p. 48*) price 12*s.* 6*d.* [62½*p*].

Boil Swill to prevent Disease

A Warning of the Danger in Waste Foods for Animals

Everyone who uses waste food for feeding animals owes it to himself and his neighbours to make sure that carelessness or negligence on his part does not cause outbreaks of foot-and-mouth disease and other animal diseases. Unboiled food scraps may contain the viruses of foot-and-mouth disease, swine fever and fowl pest.

These precautions should always be taken:

1. Boil waste foods for at least one hour before feeding to animals.
2. Do not allow sterilized swill (or any other feedingstuffs) to come into contact with raw swill.
3. Make sure that no farm animals or poultry can get into the places where you keep or boil raw swill.
4. Containers and vehicles used to carry raw swill must be thoroughly cleansed and disinfected before being used to carry livestock or anything to do with livestock.
5. Prevent dogs, cats, birds and vermin from getting at raw swill, as all of these can carry virus to other animals or poultry.
6. Never use the same buckets and shovels for handling cooked swill as you use for carrying and handling raw swill.
7. When handling raw swill wear gum boots and rubber apron or overalls, and make certain that these are changed or disinfected, and your hands are washed before you go near animals or poultry.
8. Report any suspicion of foot-and-mouth disease, swine fever or fowl pest immediately to the police. Never let a 'doubtful' animal or bird leave your premises.

The first four are rules laid down by law for the proper handling of swill and failure to observe them can lead to prosecution.

Problems of the

Intensive Cereal Grower

M. Selman, *Boxworth Experimental Husbandry Farm*

THE central problem for the intensive cereal grower today is how to maintain his income. Fixed costs rise every year but there are few signs that improvements in cereal output are keeping pace. This is particularly true of spring barley: the long-term level of yields of this crop is fairly static and perhaps falling on some farms. Even if yield has been maintained, the gross margins for barley are much lower now than ten years ago because the guaranteed price of barley, as reflected by the size of the acreage deficiency payment, is still 3*s*. per cwt below its 1959 level. The elements of the problem are declining returns, higher costs and hence reduced profits.

Simplified farming systems, in which a great part of one's income is derived from a single specialized enterprise, are very vulnerable if yields or prices are unfavourable. How can the cereal grower get out of this financial straight-jacket?

There are two major possibilities:

1. To attempt to reduce both fixed and variable costs.
2. To improve yields by better husbandry and choice of rotation.

These will need to be combined to get the best results.

Reducing costs

Attempts to reduce fixed costs must concentrate on the more efficient use of labour and machinery. Rents have been rising about seven per cent per annum and land prices are beyond our control. Cereals are easily mechanized.

To keep costs down, we must aim to use machines to their capacity by covering more land, or by harvesting heavier yields.

There are opportunities to cut variable costs. We find from experiments that we can reduce our fertilizer bills. Only 60 units of nitrogen are required at Boxworth for wheat grown after leguminous break crops such as clover or beans, compared with continuous wheat or barley which need 100 units. Using excess nitrogen costs more and depresses our yields, even in the absence of lodging. We get no response to potash fertilizers from any crop we now grow, and find that cereals need only 30 units of phosphate. We apply this as superphosphate in winter and a 20:10: 0 compound in the spring. We have cut out any autumn nitrogen for winter wheats sown before mid-November because yield gains were uneconomic. We use no fertilizer at all for beans.

Similarly, savings can be made when choosing spray materials. We use M.C.P.A. whenever it will give an effective control of broad-leaved weeds (this amounted to 44 per cent of our cereal acreage in 1968 and 27 per cent in 1969); more expensive materials are only used for 'difficult' weeds.

Higher yields through better husbandry

We can aim to grow heavier crops by better husbandry and harvest them without excessive grain losses. There are a number of factors affecting yields and our efforts on the experimental husbandry farms are concentrated on determining the extent of their effects. We have recorded yields both from trials and commercial crops, and these yield records and field diaries are of prime importance in assessing the true situation on any farm. The factors which affect our yields most are drainage, timing of cultivations, fertilizer usage, grass weeds and crop disease. If these factors are allowed to limit yields, they act like a brake on a flywheel as regards financial returns, which are liable to become progressively worse. Cereal yields are also affected by a change in the type of cereal grown or by introducing a break crop. Such changes may have an important effect on the financial returns of the whole 'rotation'.

Drainage is a basic factor and, if it is bad, will affect many others such as soil conditions, disease and weeds. Kind weather may mask the true situation for a year or two, but bad drainage usually gets progressively worse. We are fortunate in being able to mole-drain our heavy chalky boulder clay at Boxworth, but saw evidence of bad soil conditions when the recent wet autumns prevented us keeping up with our mole-drainage programme.

The timing of cultivations is often our Achilles heel. Heavy clay soil is more demanding in this respect than many other soils. The use of crawler tractors for all heavy cultivations and drilling gives us more freedom of action than the wheeled tractors would. Bad soil conditions can result as easily from the misuse of heavy-wheeled equipment under unsuitable weather conditions as from bad drainage. Once soil structure has deteriorated it can only be improved by time, good weather and correctly used power and tackle. The correct use of fertilizers, particularly nitrogen, has a very large effect on yield. Apart from avoiding wasteful expenditure by over-dressing which also reduces our yields, positive benefits can be obtained from applying nitrogen at the correct time; for example, continuous wheat yields more when about half of the spring nitrogen requirement is put on in March.

Grass weeds control

Grass weeds often depress yields. We have lost 15 cwt per acre in spring barley yields from a massive infestation of wild oats (146 per sq. yd) and find that there is a noticeable effect on yield from ten wild oats per square yard. Effective control has been found to be easier in spring barley than in winter wheat. Triallate spray has given a good control of wild oats in spring barley at a cost of about £3 per acre. Late sowing has also given a good control but reduces spring barley yields 6–8 cwt per acre compared with early-drilling. Spring wheat yields are usually much less depressed by late sowing at Boxworth. In a wet spring when drilling is unavoidably delayed it will make sense to sow wild oat infested fields last. Barban has also been used to good effect in most years, mainly in winter wheats. Thick crops of corn reduce the seed production of wild oats because of their competitive effect. This is important because wild oats are also a long-term problem due to their seed dormancy.

Blackgrass can cause serious yield losses in winter-sown cereals. Its effect on crop yield depends largely upon the relative growth rates of weed and crop. If the crop is vigorous it will suppress blackgrass; thin wheat stands resulting from bad soil conditions at drilling time encourage the weed. We have found more blackgrass when using low nitrogen rates for winter wheat. It is worst after early autumn sowing, the traditional control method has been to delay sowing until mid-November. If unsuitable weather holds up drilling until after Christmas, late sowing can cause considerable loss of yield and encourage wild oats. Triallate, terbutryne, metoxuron and methabenzthiaxuron are chemicals we are testing this autumn for control of blackgrass. On our heavy land we have been more successful in controlling couch by cultivations in a dry autumn than by any other method, but it is heartening to have paraquat as a long stop should the weather break. One advantage of winter barley is its earliness of harvest which gives an early start for stubble cultivations.

Disease

Leaf diseases can only be kept within bounds by good stubble hygiene, good ploughing, the control of volunteer cereals and the use of varieties resistant or tolerant to diseases like yellow rust and mildew. We find it is necessary to keep to a margin of safety by growing more than one variety because of rapid development of new races of some leaf diseases, and we grow at least two wheat and two barley varieties. If the use of systemic fungicides as seed-dressings proves effective and economic, it will greatly ease the leaf disease problem. Winter barley gives us better yields than spring barley but increases the risk of mildew in the latter.

Soil-borne diseases are markedly influenced by soil and location as well as by cropping over much of this country. We are fortunate at Boxworth that take-all seldom hits us very hard, even under continuous wheat or barley cropping. In part, this is an innate virtue of our soil and low rainfall. Good drainage, the relative absence of couch, the use of some early spring nitrogen and well-timed cultivations assist in staving off or alleviating the severe forms of this disease. We consistently find least take-all in winter wheat immediately after the break; thereafter, there is little consistency in the levels of infection. Quite high infections of eyespot disease can be found both on eyespot tolerant

varieties of winter wheat such as Cappelle and on spring wheats in some seasons. In cereal dominated cropping sequences the choice of varieties is limited to those possessing eyespot tolerance.

Cropping sequence

Finally, there is choice of cropping sequence. This is a potent factor influencing profits. We can look at a sequence of a break crop followed by two or possibly three, winter wheats and then spring barley grown commercially at Boxworth; and compare the yields and gross margins with those obtained from continuous winter wheat or spring barley.

Table 1

Economics of cereal rotations at Boxworth (1964–69)

	Yield	*Gross output*	*Variable costs*	*Gross margin*	
	cwt	£	£	£	
Continuous					
Spring barley	35	42	8	34	
Winter wheat (limited scale)	35	47	10	37	
Rotation					
Winter wheat	42	57	6	51	
Winter wheat	40	54	7	47	
Winter wheat	30	40	8	32	40 (average)
Spring barley	33	39	7	32	
Beans	30	44	4	40	

If climate and soil are suitable for wheat it must be considered as an alternative to barley. The guaranteed price for wheat is 3*s*. per cwt above that of barley. Good yields attract higher deficiency payments because these are paid per cwt for wheat, not per acre as for barley. New varieties of winter wheat that will soon be available show a greater potential for increased yields than do the new barleys.

Our yields of continuous barley are too low to compete financially with our 'rotation' gross margin. We would have to be able to grow 43 cwt barley per acre to compete. Continuous winter wheat crops appear to give good yields but there would be considerable problems in growing a large acreage.

It has always been considered that winter wheat should be grown after break crops. We are studying the yields of wheat grown at various stages of a continuous run and have obtained the following results:

Boxworth E.H.F.—Winter wheat, mean yields of grain cwt/acre
1966–68
(at optimum nitrogen rates)

1st crop	*2nd crop*	*3rd crop*	*4th crop*
40·8	37·3	35·2	33·3

This trial is also being carried out at High Mowthorpe and Rosemaund E.H. Farms, and there are similar trials with barley at Bridget's, Gleadthorpe and Trawscoed E.H. Farms. Yields have fallen at the other centres but at different rates.

A further series of trials on the experimental husbandry farms is investigating the effect of different break crops on subsequent cereal yields. The

break 'crops' include fallow, late-sown spring corn, beans and oats in various combinations as one- and two-year breaks. Results from these trials are just beginning to come and should be very interesting. It is of course essential to establish the level of gross margins from the whole sequence of crops. Cash crops like sugar beet and potatoes may demand added fixed resources and on heavy land they also pose considerable harvesting problems in wet autumns.

The above crops are arable breaks and those which can be combined direct will not affect levels of fixed costs. If cropping sequences containing arable break crops do not solve the disease and weed problems of the cereal grower, or do not give high enough incomes, he may have to become less cereal intensive. The real alternative may then be grass. The experimental farms are looking at methods of utilizing the grass break; the subject is not discussed in this article.

The most recent experiment on intensive cereal growing uses continuous barley as a preparation for winter wheat. If the barley can be kept free of grass weeds and the take-all decline factor comes into operation, shall we have found a new 'entry' for wheat?

John D. Leefe, B.Sc., gives an account of a three-year pilot experiment to protect and improve the environment in Lindsey

Lindsey P.I.E.

Introduction

READERS might easily surmise from the above title that they are to be enlightened about some delectable Lincolnshire dish, assuming that one of the three administrative counties within Lincolnshire, parts of Lindsey, has been recognized. The other two parts, of course, are Kesteven and Holland, these divisions being similar to the Ridings of Yorkshire. Regrettably, I must disappoint supporters of the culinary arts and quickly establish that this is an account of a three-year pilot experiment to protect and improve the environment in Lindsey. The full title of the experiment is the 'Lindsey Project for Improvement of the Environment' (abbreviated to 'Lindsey P.I.E.').

Problems of environment

No doubt anyone reading this Journal is well acquainted with the growing pressures which our environment has to face—an increasing population with higher standards of living, intensive farming methods to provide economic returns on capital, increased leisure time, more tourists, etc. A detailed account of these pressures is given in *Tomorrow's Countryside* written by the late Garth Christian. More recently, Robert Boote, under the pen-name Robert Arvill, has joined in the discussion with his book *Man and Environment*, in which principles and strategy for a conservation philosophy are suggested.

As the pressures have been recognized, the Government has introduced new legislation to enable statutory authorities to cope with the problems. The Civic Amenities Act 1967, for instance, covers the following aspects of conservation:

1. preservation of areas and buildings of architectural or historic interest;
2. preservation and planting of trees;
3. disposal of abandoned vehicles and other refuse.

The Countryside Act 1968 is a notable effort to set up a body which can consider and advise on countryside problems, exercise a watching brief on the conservation of the remaining countryside and encourage the provision, development and improvement of opportunities for the public to enjoy open air recreation. This body, the Countryside Commission, was created by renaming the National Parks Commission and extending its powers. Unfortunately, however, such legislation can only provide an administrative framework which to be fully effective must have public support, and this is only likely to be gained if the man in the street is made aware of the need for conservation measures. In this respect, the voluntary organizations can play a major part, as they are in close contact with people at grass roots level and cannot be accused of following an official policy. There is also need for such organizations to adopt practical measures themselves where statutory arrangements are inadequate and, here again, more freedom of action is possible. This is where Lindsey P.I.E. can join in as a 'catalyst', but first a word about the organization that initially sponsored the project.

'The Countryside in 1970'

Following his visit to the National Nature Week Exhibition held in London in 1963, H.R.H. The Duke of Edinburgh convened a study conference called 'The Countryside in 1970'. Some 220 leading representatives of the main competing interests in the countryside were brought together, providing an opportunity for informed discussion on the future problems of our environment. It quickly became obvious that much goodwill and co-operation would be needed if these problems were to be solved. It was also recognized that further efforts were required to study the problems before effective action could be prescribed. Accordingly, twelve study groups were set up in 1964, their reports being considered at the second conference held in 1965. As a result of these detailed reports, several important recommendations were made at the conference including, for instance, the setting-up of Countryside Committees by County Councils. A Standing Committee was also appointed to follow up the various recommendations and to arrange further studies in

depth. Specific projects to implement agreed principles and policies were also to be encouraged, one result being Lindsey P.I.E.

Lindsey project

In this case, it was felt that there was a need to explore new and effective ways of getting all the appropriate voluntary bodies to work together for the good of the countryside, both for the benefit of those who live in it and for the visitors. A successful application was first made to the Carnegie United Kingdom Trust for funds to finance a pilot scheme in a selected county. Lindsey was chosen, as highly mechanized agriculture plays an important part in the county and industrial development is forging ahead on South Humberside; Lincolnshire also has an impressive record of voluntary service. A Steering Committee was next appointed early in 1967 under the chairmanship of the Clerk of Lindsey County Council. Members appointed included the Secretary of the Lindsey and Holland Rural Community Council and Chairman of the Lincolnshire Trust for Nature Conservation, with the Secretaries of the 'Countryside in 1970' and Countryside Commission as assessors. Referees were also appointed, including the Director and Chief Rural Officer of the National Council of Social Service. Quite obviously, a committee representing wide interests and hence likely to be able to direct action where most needed.

It finally remained to recruit a project officer for the Lindsey and Holland Rural Community Council and my appointment took place in the summer of 1967; I was, at that time, working with the Forestry Commission as District Forestry Officer for South Lincolnshire and Rutland.

Early days

In September, 1967, I moved into an office provided by the Lindsey County Council. Initially the project seemed rather nebulous and I read and re-read the initial paper-work without great benefit. It was stated that the project should demonstrate the way in which voluntary bodies, individually and collectively, could collaborate both between themselves and with the

Conservation: retention of pond at Reasby Hall

statutory bodies to achieve the preservation and promotion of a high quality environment. Briefly, the aims given were as follows:

1. to collect information about the Lindsey countryside;
2. to act in liaison with the Lindsey Countryside Committee;
3. to distribute information, publicity and educative material;
4. to promote co-operative projects;
5. to promote measures for long-term liaison and co-operation between voluntary bodiesand statutory authorities over environmental issues.

After a few weeks interviewing numerous people with varied interests it became apparent that even if the project seemed nebulous, the problems were real enough.

Tree planting

As a forester, I felt that the question of tree planting was important, particularly in Lindsey where highly efficient farmers were rapidly removing hedges and hedgerow trees to produce an economic return on capital invested. Although, knowing the problems, one could sympathize, was it entirely necessary? To start with I decided to visit various farms where both tree removal and tree planting had been carried out. These visits proved encouraging; one farmer, for instance, had planted fifty-five corners of fields to encourage game. Before this he had been busy *removing* trees! Another farmer said that he was prepared to retain trees in roadside hedges and to plant small areas of land uneconomical for farming purposes. A third farmer had been planting trees for over thirty years, whilst another was not only prepared to plant trees, but to dig ponds as well to conserve wildlife!

At this stage the County Agricultural Adviser for Lindsey at that time, encouraged me to write three short articles on tree planting for farmers for the Lindsey farming bulletin. These articles proved so popular that they had to be reprinted in leaflet form under the title *Tree Planting on the Farm.* Having raised interest, it was obvious that further action was necessary. The C.A.A. and I, therefore, arranged a 'Trees on the Farm' seminar with the Principal of the Lindsey College of Agriculture, which was held at the College on 2nd October, 1968. Landowners, land agents, farmers, foresters, etc., were invited and over sixty took part. In the morning, papers on the value of trees in the countryside were given by Mr. J. R. Anthony (landscape considerations); Mr. F. W. Shepherd, Director of Experiments N.A.A.S. (effects of shelter); and by Dr. N. W. Moore, Head of the Toxic Chemicals and Wildlife Division, The Nature Conservancy (effects on wildlife). The afternoon session dealt with practical aspects of tree planting on the farm. Speakers included a Lincolnshire farmer, Mr. J. L. Roughton, who gave his views and experience of tree planting and Professor J. D. Matthews who discussed the species to plant and the need to have continuity of cover. The final paper, given by myself, dealt with financial assistance available, taxation relief and a forester's experience of tree planting in Lincolnshire. Discussion followed, under the chairmanship of the Director, East Midland Region, N.A.A.S., from which it appeared that the main problems for farmers were obtaining the right kind of advice, and finding labour both to plant and maintain trees. The result was a suggestion that an advisory group might be formed to investigate how these needs could be met.

Corner tree planting: plot at West Hall Farm

The next step, with the agreement of the Principal of the Lindsey College of Agriculture, was a meeting at the College in February, 1969. Representatives of the A.L.S. and N.A.A.S., Forestry Commission, Lindsey County Council, N.F.U., C.L.A., Council for the Preservation of Rural England (Lincolnshire Branch) Trees Committee and others were invited to attend and a useful discussion resulted. It was agreed that a paper should be prepared for the next meeting on how the County Council might extend its tree planting service, at present mainly on highway verges, to other areas, particularly waste ground on farms. This paper was agreed at the next meeting and will now be considered by the County Council. The proposed service, if accepted, could partly help to solve the problem of tree planting on farms, particularly if financial assistance is obtainable through the Countryside Act. A further meeting of the advisory group has also shown that it provides a useful forum for discussing tree problems in the county.

Ministry support

I have purposely written in detail about various efforts to promote tree planting on farms, as it should be apparent that without the support and encouragement of N.A.A.S. and A.L.S. officers, both in Lindsey and elsewhere, progress could not have been so rapid. Positive evidence of the progress claimed can be seen on a number of farms, both in the corners of fields, in hedgerows and on waste ground. But, of course, tree planting is only part of the picture. What is really required, is an appreciation by the farming community as a whole, of the need to evolve a conservation philosophy which strikes a workable balance between economic necessities and ecological principles. I was greatly heartened, therefore, by the success of the Agriculture and Nature Conservation Study Conference held at the National Institute of Agricultural Engineering, Wrest Park, Silsoe, Bedfordshire, in July, 1969 and attended by 120 or more farmers and naturalists. This was a joint exercise with representatives of the N.F.U., C.L.A., Royal Society for the Protection of Birds, The Nature Conservancy, Society for the Promotion of Nature Reserves, British Trust for Ornithology and M.A.F.F. on the organizing committee. My impression was that the naturalists, although alarmed by the proposed large-scale removal of hedges and trees from the exercise area, were, nevertheless, impressed by the economic reasons advanced for this destruction. Similarly, although the farmers were a little worried that

conservation requirements might be unrealistic, they too were impressed, in this case, by the wealth of flora and fauna which might be lost through their plans for meeting the income demanded. The compromise plan produced by the County Agricultural Adviser, Gloucestershire, gave a clear lead as to what was possible if consideration was given to both needs. I have no doubt that this exercise will stimulate action at local level and already preliminary discussions have taken place between a number of County Naturalists Trusts and County Agricultural Advisers. However, I have perhaps diverted from the path of Lindsey P.I.E. and must return to other fields of activity.

Other countryside projects

Apart from tree planting on farms, attention has also been paid to Ministry of Defence land, particularly airfields, and again there has been much encouragement from the officers concerned, although there are some disadvantages in tree planting for active stations. Several schemes have been prepared by the County Forestry Officer which we hope will eventually be accepted. Parish Councils have also been encouraged to carry out village tree planting schemes and more recently some attention has been paid to school grounds.

Other work has included the preliminary organization of village face-lifts, working with C.P.R.E. (Lincolnshire Branch); the preservation of historic buildings, serving with the Lincolnshire Historic Buildings Joint Committee; and the preparation of nature trails together with visitor surveys, working with the Lincolnshire Trust for Nature Conservation. A windmill trail has also been proposed and a directory of organizations concerned with the countryside in Lindsey is being prepared. A number of schemes for picnic sites and country parks have also been put forward for consideration by the Lindsey Countryside Committee.

Assistance with countryside conferences is another field of activity and a Farm Buildings Conference was organized by the project in January, 1969. The Land Commissioner for Lindsey and Kesteven gave valuable assistance in this connection and has supported the project in other ways. Incidentally, the Minister of Agriculture also helped with the improvement of the environment in Lindsey when he ceremoniously planted a 30 ft semi-mature beech tree at the Lincolnshire Showground on 18th July, 1969. This tree, donated by Civic Trees Ltd. as their contribution to the work of the project, appears to be thriving.

Needless to say, many lectures have been given to a wide variety of audiences, including Women's Institutes and Parish Councils. Altogether, the scope is tremendous and I hope that this account will have shown that we are trying to meet the challenge and stimulate efforts in a number of directions.

Conclusions

With another year to go, it is perhaps unwise to draw firm conclusions at this stage. However, it is fairly clear that there is a role for a 'Countryside Officer' or 'Rural Liaison Officer', call him what you may, simply working with all the various interested parties in the countryside. Such a person needs to be well-versed in some form of land-use and to have a real interest in the countryside. Links with both statutory and voluntary organizations are required at both national and county level. In addition, an impartial outlook is a 'must' and it is, therefore, difficult to name the employer. The possibilities

rest with the Countryside Commission, Local Authorities and Rural Community Councils. A linkage similar to Lindsey P.I.E. might be the answer, with the funds coming from both central and local government.

Perhaps readers will look out for our final recommendations in the report which is to be presented to the third and final 'Countryside in 1970' conference to be held in London in October, 1970? In the meantime, may I leave you with my appeal to consider the whole question of conserving our environment. If not already committed, I hope you will join forces with those who are concerned about the wise and prudent use of our natural resources, we need your help!

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This article has been contributed by **John D. Leefe, B.Sc. (For.), A.S. For.**, Project Officer of the 'Lindsey Project for Improvement of the Environment', who is a District Forestry Officer on loan from the Forestry Commission.

The Ministry's Publications

Since the list published in the December, 1969, issue of *Agriculture* (p. 611) the following publications have been issued.

MAJOR PUBLICATIONS

BULLETIN

No. 100. Diseases of Bees (Revised) 7*s.* [35*p.*] (by post 7*s.* 4*d.*) [36½*p.*] (SBN 11 240400 6)

TECHNICAL BULLETIN

No. 15. Nitrogen and Soil Organic Matter (New) 40*s.* [£2·0] (by post 41*s.* 7*d.*) [£2·08] (SBN 11 240915 6)

FIXED EQUIPMENT OF THE FARM LEAFLETS

No. 7. Cattle Grids for Private Roads (Revised) 2*s.* [10*p.*] (by post 2*s.* 4*d.*) [11½*p.*] (SBN 11 240547 9)

Priced publications, except where otherwise stated, are obtainable from Government Bookshops (address on p. 48) or through any bookseller.

The following publication is available only from the Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middlesex. HA5 2DT. This publication is not for re-sale.

N.A.A.S. Advisory Papers No. 5—Magnesium in Agriculture (New) 1*s.* 9*d.* [9*p.*] (by post 2*s.* 1*d.*) [10½*p.*]

30. Montgomeryshire

T. M. K. Evans

THE county of Montgomeryshire sits astride the centre of Wales, from the tidal waters of the Dovey Estuary to the Shropshire borders. The extreme west of the county enjoys a maritime climate. But in the space of a few miles, the land rises sharply to over 2,000 ft, the annual rainfall increases to 90 in. and the growing season shortens to five months or less. Further east, the land falls but is generally over 600 ft, with the exception of the main river valleys. The rainfall also decreases in the shadow of the Cambrian mountains so that the border districts receive only 27–30 in. annually.

The urban areas are small. The biggest towns—Newtown and Welshpool—have populations of approximately 6,000 while the county population is only 43,000. Welshpool is a thriving market town with a sizeable industrial estate. Its livestock market is the largest in the county, although smaller markets continue to function in several other towns and villages. While Welshpool's expansion has been and is self-generating, a Development Corporation has recently been set up to double the population of Newtown over the next seven to ten years. The establishment of advanced factories, coupled with the advantages to industrialists of operating in a development area, will, it is hoped, persuade both industry and its requisite labour force to move into the area, thus reversing the steady outflow of labour to the industrial Midlands.

Since its principal rivers flow eastwards, Montgomeryshire has always been vulnerable to successive invasions along the valley bottoms from the east. The Romans traversed the county, the Normans, in a series of attacks, succeeded in dominating the valleys and were soon to be followed by the Marcher Lords. Each has left its mark, Roman towns, encampments and roads, Norman castles and fortified manors and the black and white farmsteads more commonly associated with the Midland counties. While the Welsh were driven to the hills in the north and west and it is really only here that Welsh continues to be the first language.

Montgomeryshire was once famous for its oaks from which many an English man-o-war was built. There are still considerable areas of afforestation—though now mainly conifer. These forests provide opportunities for employment in otherwise extremely rural areas. In the nineteenth century it became noted for its Shire horses, its Hereford cattle and Welsh sheep and its Red clover.

Like the Romans and Normans before, the dairy cow came from the east along the principal valleys. Today, dairying has made successful incursions up into the more marginal upland areas. One-third of the county's farms are in dairying. The majority have herds of 25–50 cows, but there is a considerable and increasing number of larger herds. Dairy farmers have rapidly adopted new techniques. Many are equipped with parlours and cubicle sheds with facilities for easy-feed hay. Paddock grazing has been widely adopted and the stocking density is generally 1·5 acres per cow or better.

The livestock rearing area can be sub-divided into the better upland areas with little or no rough grazing and the true hill farms with larger areas of enclosed rough grazing or open hill. Formerly the store cattle enterprise was based on the Shorthorn × Hereford cow. Now, in the better areas, stocking rates are extremely good; Hereford or Hereford × Friesian cows are maintained, or dairy-beef store cattle reared, and the Kerry Hill ewe or the Speckled-face and other improved strains of Welsh ewe are able to be kept. These improved breeds of cattle and sheep result in higher gross margins and a reasonable net farm income per acre, although the usually small acreage of these farms still leads to a low general level of income.

The higher and poorer hill land is commonly in larger units, but it is usually possible to maintain only the pure Welsh ewe and Welsh Black or cross bred cows.

The gross margins are low, partly due to the extensive nature of the enterprises. Many hill farms have been modernized—with new farmhouses and improved buildings. But winter housing for cattle is often the factor limiting expansion. The sheep flock has increased by 10,000 ewes annually to 430,000. The development of a cheap but satisfactory sheep house on the lines of that used at Trawscoed Experimental Husbandry Farm has enabled a number of sheep farmers to consider housing all, or part, of their flock from January to lambing and so reduce the pressure on grassland at that time. The improved lambing percentage and wool clip, higher birth weights of lambs and the resultant improvement in grassland production will generally service the new capital investment.

Only 20,000 acres of cereals are grown—80 per cent of this acreage is on the fertile farms of the valleys in eastern Montgomeryshire. Yields are generally high—with two tons per acre from winter wheat and oats and 38 cwt per acre from spring barley commonplace. Most cereal farms are equipped for drying and storage of grain for sale or have facilities for moist storage of grain for home-mixed livestock rations. Many of these larger cereal farms have sizeable poultry and/or pig enterprises which utilize the home-grown feedingstuffs.

Montgomeryshire's other resource is water. Lake Vyrnwy was constructed by Liverpool Corporation in 1891 and the waterworks and adjoining farmland and forests have provided employment for over 100 men since that time. More recently the Clywedog Dam has been completed and contains the Nation's first regulating reservoir, maintaining the level of the River Severn in summer for extraction by the Midland towns and retaining heavy rainfall in winter to alleviate flooding in the upper Severn valley.

Despite the inroads of new urban development, of reservoirs and forests in the county's acres, agricultural production and productivity continues to rise. With the astute stockmanship of its farmers, improving grassland management and their recent capital investment, the future of agriculture in the county is assuredly rosy.

The Modern Farm Workshop

M. G. C. Kent, *Agricultural Land Service, Maidstone*

THE giant strides taken by engineering technology in the past decade have not left the modern farm untouched and this has led not only to an increase in the variety and amount of mechanical equipment on the farm, but also to an increase in its complexity. As profit margins get narrower, the farmer must be able to rely increasingly on his equipment working without breakdown whenever required. These factors combine to force the farmer to require an ever increasing standard of skilled maintenance of his equipment as a safeguard against mishap in busy periods.

However, in many areas other changes are taking place. For example, the local small garage or agricultural engineer is being submerged by larger concerns which may lead to the farmer losing the personal and dependable service on which he had hitherto been able to rely for servicing and repairing his equipment.

Depending on the scale of his farming, one of the surest ways of overcoming these increasing problems is for the farmer to provide himself with a good farm workshop, and to ensure that someone on the farm is sufficiently skilled to make use of it for at least emergency repairs and maintenance of his equipment.

All too often the workshop is one of the most neglected buildings on the farm, despite the fact that practically every other farm operation could come to grief if equipment fails. The workshop is, of course, not only the place to maintain field equipment, but it is also the centre for the maintenance of building equipment like fixed conveyors, gates and fittings, plumbing parts and, in fact, many other items found on a farm. It is impossible to repair or maintain complex equipment satisfactorily in a dirty, dark and damp building; tools are lost or become rusty, parts taken off machines are put down where they pick up mud and grit and it is very difficult under these conditions to keep a reasonable check on stocks of spares. If the greatest benefit is to be obtained from a workshop, it must, therefore, be inviting, easy and safe to work in.

Type of building

How can these requirements be met? First, bear in mind that much of the time spent in the workshop is likely to be during the winter months and, therefore, the advantages of providing an insulated building must be considered, particularly in colder areas. The walls and floor should be damp proof; this can be achieved, for instance, by using cavity walls and a membrane under the concrete floor. Adequate natural and artificial lighting must be provided. Windows, particularly on the north side, are probably better

than roof lights as they tend to produce fewer shadows. Apart from overall artificial lighting there should be localized lighting at focal points of the work bench. Some simple and safe form of heating might also be provided.

Siting and layout

The siting of a workshop is important and ideally it will be placed central to the main area it must serve, with easy access for mobile equipment. Adequate forecourt space for parking machinery to be washed and serviced should be provided. To reduce the fire risk it is desirable that the workshop should be well away from hay and straw storage barns and livestock buildings. Doors must be of adequate size to allow access for all types of machinery. An opening 12 x 12 ft should be large enough and a personnel door to allow access in cold weather without opening the large doors is advisable.

Once inside the workshop it must be possible to find the required tools immediately without time consuming searching. Where tools can be hung up, a shadow-board is a great aid to ensuring that each tool is returned after use to the same place, even by someone who is unfamiliar with the workshop. Clearly labelled boxes, drawers or cupboards should be provided for smaller articles. 'A place for everything and everything in its place' should be the motto. If spares are kept, the same will apply; clear labelling and a simple reference system will cut out fruitless searching and make it easier to keep a check on what is there, hence lessening the risk of running out of vital parts.

Safety

That a workshop must be safe to work in goes without saying. If the points already made are followed then many of the likely hazards will be avoided. Good lighting and ventilation are essential, the latter to avoid accidents caused by toxic exhaust gases and other fumes. The floor should be laid dead level to stop vehicles which are being worked on with the brakes off from creeping. Clear labelling has already been mentioned and this applies particularly to dangerous equipment and chemicals, for which the provision of a large built-in wooden cupboard fitted with a mortice dead lock and key and clearly labelled should be considered. There is always a fire risk in a workshop. To combat this, water draw-off taps with standardized pattern screw nozzle outlet to which a hosepipe can be connected should be provided; also chemical fire extinguishers and buckets of dry sand.

Tools and equipment

The right tools must be provided for every job that the workshop is expected to undertake. Although some capital outlay is involved good quality tools are always a worthwhile investment as they will last a lifetime and, when compared with repair bills, the outlay may not be excessive. In the same way that a well laid out restaurant is likely to inspire better table manners than an untidy cafe, so will a well equipped workshop inspire a higher standard of workmanship than could be expected in badly equipped premises.

Finally, no matter what care is taken and no matter how inviting, easy and safe the workshop is to work in, accidents are always bound to happen. A good first-aid kit and some elementary training can so easily be the difference between a minor accident and tragedy.

Further advice on requirements for farm workshops is given in Fixed Equipment of the Farm leaflet No. 25, *The Implement Shed and Farm Workshop* from H.M.S.O. (addresses on p. 48) or through any bookseller, price 2*s.* 3*d.* [11*p.*] (by post 2*s.* 7*d.*) [13*p.*]

in brief

- **British beef in the 'seventies**
- **Turkey promotion**
- **More bulk milk**

British beef in the 'seventies

As we go into the 1970s, a pre-eminent target of British farming will be the expansion of home-produced beef—always provided that the product enjoys consumer acceptance in terms of quality and price. In a word, British beef must be fully *competitive* with other meats, notably poultry and pig meat, if it is not to run into resistance on the public side of the retail counter. At the same time the price must leave sufficient margin for producer and distributor, wherein lies the need for close re-examination of the complete beef production-marketing cycle. Between 40 and 50 per cent of our home-produced beef currently comes from dairy herd calves, about 20 per cent from suckler calves and 15–18 per cent from imported Irish stores, leaving a balance filled by culled breeding cows. In total 3,592,000 home cattle were slaughtered for beef in 1967.

These figures were given by Dr. H. K. Baker, Deputy Director (Livestock) of the Meat and Livestock Commission, at the Harrogate conference on 'Modern Beef Production' organized by I.C.I. in the autumn. The producer's room for manoeuvre in profitable beef production lies, like all other forms of meat production, primarily within the factors of growth-rate, the efficiency of food conversion and his managerial skill relative to the system chosen. Good stock performance is vital. 'Fortunately, the genetic factors for growth in beef cattle are fairly strongly inherited', he said, 'so that a selection programme aimed at breeding animals with a high growth potential can give positive results in a relatively short time. Thus data which has been collected in this country over the past 3–4 years have shown that beef sires which are 100 lb above the herd average weight at 400 days produce progeny which are on average 22 lb above the weight of their contemporaries at 400 days of age.'

Dr. Baker also spoke of the potential of commercial suckler calf production, but not to be confused with the kind where a traditional beef-type, low-milking cow on an extensive system produces on average less than a calf a year, needs 2 acres or more and the growth-rate of the calf is no more than 1½ lb/day. New evidence, he said, is suggesting that, particularly on arable farms in the East and the South, there may well be a place for a new type of suckler cow herd. 'The cow will be a beef-cross Friesian (or dual-purpose type) and will have sufficient milk to support a calf growing at 2–2½ lb/day. High growth-rate beef bulls will be used as the final cross to give calves with a high growth potential and with the capacity to finish on relatively low concentrate diets. The cows will need to be overwintered as cheaply as possible on rations based on straw and other arable by-products, possibly supplemented with urea. If stocked at a cow, or more, to the acre during the grazing season, it is possible to achieve the target gross margin of £40 per cow and £30 per acre.'

Turkey promotion

THE days when turkey was a luxury food confined almost exclusively to Christmas conviviality are now preserved only in recollection. Improved nutrition, skilled management and better and exact breeding for an extended market, whether for small 10–16 week old birds or the larger, mature birds, has been supported by a tireless market promotion. So much so that today the British Turkey Federation can point to the fact that in the past ten years turkey sales have increased from 4 million to 14 million a year. Behind this considerable progress has been the support of the contributors to the B.T.F. levy funds, which now stands at an estimated 90 per cent of the industry.

The once-a-year 'festive friend' can now be described as a highly competitive, readily available product, with a holiday bias. For the first time in the history of the trade more than half the crop last year was sold through the year outside the Christmas period. The demand at Easter is now approaching 2 million birds, and the Whitsun and summer Bank Holiday are accounting for ½–¾ million. Weekend sales throughout the year are in the region of 20,000–30,000. And to this must be added the growing demand by the catering trade.

But as great as the success now reported, this does not imply any invitation to relax effort, as Colonel U. Corbett, the retiring Chairman of the B.T.F., emphasized in his valedictory speech at the Federation's Annual General Meeting. 'We have to improve on this ratio if the industry is to make serious growth in future years', he said. 'Here we will be helped by the sale of cut-up turkey and other processed products. With all these avenues open, our progressive industry should be able to face the future with confidence . . . One of the most rewarding features of poultry meat marketing during the last few years has been the improvement in the relationship which exists between producers and the wholesale and retail trade. Today we are beginning to recognize that production and marketing must become more and more a combined operation.'

Colonel Corbett is succeeded as Chairman of the British Turkey Federation by Mr. Dennis Martin.

More bulk milk

WHEN the M.M.B. started bulk milk collection in February 1955, it was greeted with no great enthusiasm. But the Board's long-term objective for all farm milk to be collected in bulk is now seen to be paying off. The latest information shows that about 3,000 new farms are annually installing refrigerated milk vats. Whereas by 1964 the number of farm vats installed was 3,733, supplying 517,000 gal a day from 3·7 per cent of producers, the comparable figures for 1968 are 12,095 vats, and 1,760,000 gal a day from 14·4 per cent of producers. Approximately one-third of total supplies are now in bulk form.

The deepening pattern of modern milk production in which fewer producers are supplying a higher total quantity means that there are not so many pick-ups but a greater gallonage per stop. There are also fewer receiving dairies—under 700, compared with 1,850 ten years ago. So, too, the number of haulage units. In 1964 there were 4,283 vehicles operating daily from 904 transport depots; the growth of bulk collection has reduced these figures to 3,363 vehicles at 605 depots. When the tanker started to oust the churn the average output of milk per farm in England and Wales was about 35 gal a day. By the mid-70s the average could reach 80 gal and, in some areas certainly, there may hardly be a churn in sight.

AGRIC

Books

Dormancy and Survival. (Symposia of the Society for Experimental Biology). No. 23. Edited by H. W. WOOLHOUSE. Cambridge University Press, 1969. £5.

Despite hard winters, prolonged droughts and other vagaries of soil and season, pests and diseases, weeds and vermin, the oak and the ash renew their activities each year with a remarkable, rhythmic precision which the intrusion into the countryside of man's technologies has not yet eliminated. The devices which enable organisms to endure conditions of adversity have been the subject of intensive investigation by biologists for many years and in this volume are gathered detailed and authoritative accounts of recent studies which compass a vast field.

The behaviour of bats, beetles, bacteria, potatoes, eelworms, squirrels and trees are some of the subjects analysed. That so heterogenous a company should find themselves within one cover is indicative of the unification of thought achieved in the biological sciences in recent decades through the progress of molecular biology and its associated disciplines. Indeed, one finds that the problems of cold and heat tolerance in plants and animals are studied not merely in terms of enzyme action and the chemical nature of the cell constituents but also in relation to the folding, bonding and denaturing of the very protein molecules themselves.

Assessment of individual contributions would be out of place here, but it will suffice to say that the twenty-two papers were presented by a distinguished international group of biologists meeting under the aegis of the Society for Experimental Biology in 1968 at the University of East Anglia. The high standard of presentation and scholarship maintained by this Society needs no emphasis.

Although essentially a reference work for specialists, farmers and other applied biologists with sixth-form biology and chemistry behind them, would, nevertheless, find large sections of this book of intriguing interest. In the book of Ecclesiastes we are reminded that 'To everything there is a season and a time to every purpose under heaven'. The revelations of science concerning the ways in which living things achieve 'their season and purpose' are indeed remarkable and worthy of dissemination far beyond the limited group who will purchase this volume.

I.W.S.

The Farm Wagons of England and Wales. JAMES ARNOLD. John Baker, 1969. £6 10*s*. (£6·50).

Earlier books by James Arnold have dealt with a range of rural crafts. His latest work with its twenty-four beautiful, coloured drawings deals exclusively with farm wagons that were built in the leisurely days before mass production and standardization were scarcely heard of—when every country district had its own craftsmen capable of producing essential, every-day things, that besides being useful often charmed the eye as well.

One only has to examine Mr. Arnold's large folio size drawings to realize that nothing about a farm wagon escapes his eye: in my view their draughtsmanship and colouring lend them a vitality that the finest of model farm wagons in our agricultural museums cannot match. The drawings are beautifully reproduced, by offset lithography, in full colour and each bears on its reverse a commentary supplementing the main text.

As the title wheelwright implies, the most exacting of his tasks is the making of wheels. Perhaps for this very reason the section on the problems of designing and construction of wheels tends to be one of the highlights of the book. The individualism of the old-fashioned craftsmen is implied on almost every page. For example, a table of local names warns us that crook, bed bearer, side, main-side, sole and blade are not different parts of a wagon but different local names for the same part.

This book, limited to 1,800 copies signed by the author, is such an elegant production that one can only dismiss the misprinting of lines 15–17 on page 16 with a sigh.

A.J.L.L.

books received

Electricity and Potato Husbandry and *Electric Farming*. Electricity Council, 1969. Individual copies free from Electricity Boards.

Land Use and the Constitution of Property. D. R. Denman. Cambridge University Press, 1969. 5*s*. [25p].

Vertical Integration in Agriculture and the Role of the Co-operatives. M. W. Butterwick. Copies from the Central Council for Agricultural and Horticultural Co-operation, Vincent Square, London, S.W.1. 15*s*. [75p] plus postage and packing.

Meat. A Review of production, trade, consumption and prices relating to beef and veal, mutton and lamb, pig-meat, poultry-meat, offals, canned meat. The Commonwealth Secretariat, 1969. 30*s*. [£1·50].

National Institute for Research in Dairying. Report 1968. University of Reading. 15*s*. [75p].

Farm Planning Data 1969. J. G. Davidson. Agricultural Economics Unit, University of Cambridge. 7*s*. [35p] (including postage).

Proceedings of the Third Nutrition Conference for Feed Manufacturers. Edited by Henry Swan and Dyfed Lewis. Churchill, 1969. 25*s*. [£1·25].

Agricultural Chemicals Approval Scheme

Ninth List of Additions to the 1969 List of Approved Products for Farmers and Growers.

BINAPACRYL
Colloidal and Wettable Formulations
Morocide Liquid (a suspension)—**Boots**
Morocide Liquid (a suspension)—**Hoechst**

MECOPROP alone
Liquid Formulations
Compitox Extra—**May and Baker**

PHORATE
Granular Formulations
Engro Phorate 10G—**Esso**

2,4,5-T alone
Unformulated Esters
Campbell's 2,4,5T-MB Ester—**Campbell (Sales)**

Ninth List of Additions to Supplement No. 1 of Chemicals for the Gardener

BAYWOOD ELVARON FUNGICIDE—**Baywood**
A formulation of dichlofluanid, for control of grey mould (Botrytis) on strawberries and other soft fruits.

CARTERS SLUG KILLER PELLETS—**Carters**
A pelleted bait based on metaldehyde

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